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HESPEROPITHECUS, THE FIRST ANTHROPOID PRIMATE FOUND IN AMERICA

IT is hard to believe that a single small water-worn tooth, 10.5 mm. by 11 mm. in crown diameter, can signalize the arrival of the anthropoid Primates in North America in Pliocene time. We have been eagerly anticipating some discovery of this kind, but were not prepared for such convincing evidence of the close faunal relationship between eastern Asia and western North America as is revealed by this diminutive specimen. The entire credit for the discovery belongs to Mr. Harold J. Cook, consulting geologist, of Agate, Nebraska, who has been contributing for many years to our knowledge of the extinct fauna of Nebraska through both his discoveries and his writings. He wrote to the present author (February 25, 1922):

I have had here, for some little time, a molar tooth from the Upper, or Hipparion phase of the Snake Creek beds, that very closely approaches the human type. It was found associated with the other typical fossils of the Snake Creek, and is mineralized in the same fashion as they are. I sent a brief description of this to Professor Loomis a short time before the Amherst meeting of this year, with a request that it be read at that time, if opportunity offered. The manuscript was returned to me here immediately after the meetings, but with no notation as to whether it was read or not, or presented at that time in any fashion.

Inasmuch as you are particularly interested in this problem and, in collaboration with Dr. Gregory and others, are in the best position of any one to accurately determine the relationships of this tooth, if it can be done, I will be glad to send it on to you, should you care to examine and study it. Whatever it is, it is certainly a contemporary fossil of the Upper Snake Creek horizon, and it agrees far more closely with the anthropoid-human molar, than that of any other mammal known.

On receiving the tooth, the author telegraphed (March 14, 1922): "Tooth just arrived safely. Looks very promising. Will report immediately." A letter followed the same day:

The instant your package arrived, I sat down with the tooth, in my window, and I said to myself: "It looks one hundred per cent. anthropoid." I then took the tooth into Dr. Matthew's room and we have been comparing it with all the books, all the casts and all the drawings, with the conclusion that it is the last right upper molar tooth of some higher Primate, but distinct from anything hitherto described. We await, however, Dr. Gregory's verdict to-morrow morning; he certainly has an eagle eye on Primate teeth. . . . We may cool down to-morrow, but it looks to me as if the *first anthropoid ape of America* had been found by the one man entitled to find it, namely, Harold J. Cook!

On March 22, 1922, the author wrote:

We believe we have found another one of the teeth, very much worn, of the same animal, which, so far as it goes, is confirmatory. The animal is certainly a new genus of anthropoid ape, probably an animal which wandered over here from Asia with the large south Asiatic element which has recently been discovered in our fauna by Merriam, Gidley and others. It is one of the greatest surprises in the history of American paleontology and I am delighted that you are the man who found it. Our specimen is unrecognizable, it is so much worn.

The tooth arrived with the following label:

One Molar Tooth, ?Anthropoid, No. HC425, Collection of Harold J. Cook, Agate, Nebraska. Found in Upper Phase of Snake Creek Beds, Typical Locality, in position in gravels with other fossils.

Following the examination by Dr. William D. Matthew and the author, who determined the tooth as a second or third upper molar of the right side of a new genus and species of anthropoid, the tooth was submitted to Curator William K. Gregory and Dr. Milo Hellman, both of whom have made a special study of the collections of human and anthropoid teeth in the American Museum and the United States National Museum. They reported (March 23, 1922) as follows:

1. Such a degree of wear is very rarely seen on m^3, and in view also of the marked difference in form of m^3, we rather incline to the opinion that it is an m^2. 2. The kind of wear shown in this tooth, which has an evenly concave surface (without humps representing the para- and metacones), has never been seen in an anthropoid tooth, and we are of the opinion that even in very old chimpanzees the outer half of the crown will be unevenly worn. 3. The nearest in point of wearing surface is the supposed m^2 attributed to *Pithecanthropus*, also in form of roots. The strong hypocone in "*Pithecanthropus*" and the absence of hypocone in the new specimen is not positively diagnostic, in view of the immense differences in the hypocone, both in apes and man. 4. On the whole, we think its nearest resemblances are with "*Pithecanthropus*" and with men rather than with apes.

On the basis of these very careful studies, the author decided to make this tooth the type of the following new genus and species:

Hesperopithecus haroldcookii,[1] new species

This second upper molar tooth is very distant from the gorilla type, from the gibbon type, from the orang type; among existing anthropoid apes it is nearest to m^2 of the chimpanzee, but the resemblance is still very remote. It is excluded from close affinity to the fossil Asiatic anthropoid apes, such as *Dryopithecus punjabicus*, *Palæopithecus sivalensis*, and *Sivapithecus*, recently related to the human stem by Pilgrim. Its transverse diameter of 11 mm. is greater than its anteroposterior diameter of 10.5 mm. In the corresponding human tooth, m^2, of an American Indian, with which it is compared in Fig. 2, the transverse diameter is 12.5 mm., the anteroposterior diameter is 11 mm. Thus the proportions of the molar crown of the *Hesperopithecus* type are about the same as those in the *Homo sapiens mongoloideus* type. There is also a distant human resemblance in the molar pattern of *Hesperopithecus*, as very skilfully portrayed (Fig. 1)[2] by the artist, Mrs. L. M. Sterling, to the low, basin-shaped, channeled crown in certain examples of *Homo sapiens*. But the *Hesperopithecus* molar cannot be said to resemble any known type of human molar very closely. The author agrees with Mr. Cook, with Dr. Hellman, and with Dr. Gregory, that it resembles the human type more closely than it does any known anthropoid ape

[1] The names signify an anthropoid of the Western World discovered by Mr. Harold J. Cook.

[2] The illustrations will be published by the American Museum of Natural History.

type; consequently it would be misleading to speak of this *Hesperopithecus* at present as an anthropoid ape; it is a new and independent type of Primate, and we must seek more material before we can determine its relationships. It is certainly not closely related to *Pithecanthropus erectus* in the structure of the crown, for *Pithecanthropus* has a single, contracted crown in which the superior grinding surface has a limited crenulated basin, whereas *Hesperopithecus* has a widely open crown with broadly channeled or furrowed margins, and a postero-internal crest suggesting the hypocone of a higher Primate form. The disposition of the roots in *Hesperopithecus,* in *Homo,* in *Pithecanthropus,* is shown to be very broadly similar in comparative Fig. 2. The *Hesperopithecus* molar is three-fanged, the postero-external fang having been broken off in the type; the internal fang shows a median internal groove and a tendency to a deep external groove on the outer side.

Since 1908 there has been in the American Museum collection from this same horizon another small water-worn tooth, discovererd by Dr. William D. Matthew. The specimen belonged to an aged animal and is so water-worn that Dr. Matthew, while inclined to regard it as a Primate, did not venture to describe it. It now appears, from close comparison with the type of *Hesperopithecus,* to be closely related generically, even if it is not related specifically. The greatly enlarged drawing (Fig. 3), reproduced to the same scale as that of the type above described, shows that the molar pattern is fundamentally similar. The crown differs in its much more triangular form and, were it not for its extremely worn surface, we should unhesitatingly pronounce it as a third superior molar; it has, therefore, been given this position provisionally in the diagram; it seems to confirm the opinion of Gregory and Hellman that the type of *Hesperopithecus* is a second superior molar.

The geologic age of these two specimens is now believed to be the same as that of Thousand Creek, Nevada, and Rattlesnake, Oregon, among the fauna of which *Pliohippus* is very abundant and varied; it also contains *Ilingoceras* and other strepsicerine antelopes of Asiatic affinity; it is the last American fauna in which occurred the rhinoceros, preceding the Blanco fauna in which the Asiatic brevirostrine *M. mirificus* first occurs.

HENRY FAIRFIELD OSBORN
AMERICAN MUSEUM
OF NATURAL HISTORY,
NEW YORK, N. Y.

MEDALS AND DINNER OF THE NATIONAL ACADEMY OF SCIENCES

AT the annual dinner of the National Academy of Sciences, held at the Hotel Powhatan on Tuesday evening, April 25, 1922, two medals were awarded.

The J. Lawrence Smith Medal was bestowed upon Dr. George P. Merrill, curator of geology at the United States National Museum. This is a gold medal of the value of $200, from a fund established in 1884, as a reward for "original investigation of meteoric bodies." But because investigators in this field are so rare it has not been given since 1888. Dr. Whitman Cross, in his speech presenting the medal, pointed out that Dr. Merrill had continued to carry on the work of his predecessor, J. Lawrence Smith, on meteorites by the application of modern methods of analysis. The earlier analyses of meteorites were not always to be relied upon, and Dr. Merrill in his long years of research has been able to show that some of the elements previously reported as having occurred in meteorites are absent and, at the same time, he has extended the list of elements and compounds that do exist in these bodies. Among other minerals he has found a calcium phosphate similar to apatite, which has been named in his honor Merrillite. Dr. Merrill also has discovered evidences of metamorphism in meteorites, cases where a mineral structure has been broken up and the fragments later fused together like the conglomerates found in igneous rocks in the earth's crust.

Dr. Merrill in receiving the medal said that meteorites had in all ages attracted a great deal of popular interest. In the earliest times they were worshipped as divine and nowadays the newspapers give great attention to any meteoric fall. Yet few scientists have made them the subject of concentrated and long-continued study. In his work, Dr. Merrill said

he had tried to keep his feet upon the earth as though his shoes had leaden soles and to leave to others premature speculation as to the origin of these bodies. It is evident from their composition that they come from regions where there was no air, for they contain iron, both in a free state and in compounds that are not stable in the presence of oxygen. From their structure it is evident that some have undergone secondary igneous changes. In conclusion, Dr. Merrill quoted the verse, "All my dreams come true to other men," and said that he would leave the developments and deductions from his work to future investigators and "may all my dreams come true to other men."

The address bestowing the Daniel Giraud Elliot Medal for the year 1920 was made by Dr. Henry Fairfield Osborn, of the American Museum of Natural History, New York City. This medal is intended to be awarded every year for contemporary contributions to zoology. Previous awards were made to F. M. Chapman, C. W. Beebe and Robert Ridgway. Dr. Osborn sketched the history of paleontology from the time when Cuvier first announced the law of correlation. But the ability of the biologists to restore an extinct animal from a single bone was exaggerated and for a time such general theoretical work fell into disrepute. The great American paleontologists, Leidy, Cope and Marsh, limited themselves mostly to description. But now again the time has come when general principles and relationships may be founded upon a more substantial basis. Among the young investigators who are taking up this work is Professor Othenio Abel, of Vienna, who has undertaken a general study of the causes of evolution. His guiding thought is that morphology depends upon physiology and that to understand a form we must know its function. Professor Abel pursued his studies even during the war when his family was in such distress that he had to send out his children to friends for food, and in 1920 he produced an inspiring work, entitled *Methoden der Paleobiologischen Forschung.*

In the absence of Professor Abel the medal was received by Edgar L. G. Prochnik, Austrian chargé d'affaires, who said that all Austria would rejoice over this honor done to one of her citizens. Conditions in Austria are exceedingly hard at present on account of the curtailment of Austria's resources and it is felt that the future of Austria lies in the mental power of her sons. The Austrian scientists are determined to bring their country to the rank which she occupied in science and art previous to the war. The disposal of this medal was another proof that science was not limited in its scope to creed or nationality. Professor Abel serves in the ranks of science, the peace maker.

President Walcott, in handing over the medal to the representative of the Austrian Legation, said that the award would carry with it an honorarium which was to be forwarded to Professor Abel.

Next, Dr. Vernon Kellogg, permanent secretary of the National Research Council, was called upon to tell something of the work and plans of that institution. The National Research Council, he said, was the child of the National Academy of Sciences, born in the tempestuous times of the war. The child had grown with amazing rapidity and had manifested the characteristic virtues and defects of lusty youth. Some of its parents—the use of this unconventional plural is justified by the collective parenthood—do not know whether to be proud of it or uncomfortably disturbed by it. The motto of the National Research Council is "cooperation and organization." The latter word was looked upon with disfavor and even suspicion by some scientists, but, rightly understood, as the council interprets it, there was nothing to fear from it. He had recently been reading the reports of the visits that had been paid by members of the council to 150 universities, colleges and other laboratories. In all these were found men earnestly engaged in research, often under disheartening conditions and in isolation. The National Research Council can aid and encourage these scattered and ill-equipped scientists to work out their plans in a concerted way. Nothing shall interfere with the individual freedom and initiative which are the main strength of scientific endeavor. Apart from the endowment and building fund, the National Research Council had raised over a million and a half dollars, which was being expended in promoting research

work in various lines. Plans for the new building had been exhibited at this session of the academy. This building will cost about $1,300,000, this money being provided by the Carnegie Corporation, and $200,000 had been provided by a score of private donors for the purchase of the ground. The edifice will be worthy of standing in the group of patriotic, philanthropic, international and memorial structures, and here the National Academy of Sciences and her daughter, the National Research Council, may live together in peace and happiness.

The president then asked Dr. William H. Welch to speak on the new School of Hygiene and Public Health founded at Johns Hopkins University and endowed with six millions from the Rockefeller Foundation. Dr. Welch said that the prevention of disease in communities as distinct from the cure of disease individually was comparatively a new profession. The beginning of the public health work may be traced back to the seventeenth century, when three great discoveries were made. One was Captain Cook's success in preventing scurvy in his long voyage in the Pacific by the use of vegetable vitamines. The second was the discovery of the cause of "Devonshire colic," which was found to be due to lead poisoning from the drawing of cider through lead pipes. The third was the introduction of vaccination for smallpox. The Napoleonic wars set back work in this direction as in others, but in the great reform year of 1848 the English Parliament passed the Public Health Act. Then began a campaign directed against filth and for sanitation, water supply and sewage disposal. Now with our new knowledge of the causes of infection and epidemics, public health can be guarded as never before. Yellow fever has been swept from its old haunts, malarial fever can be controlled and typhoid has become so rare that it is difficult to teach it for want of cases. In Baltimore last year a single death from typhoid aroused great excitement among the students who were eager to attend the autopsy as the only opportunity they had to become acquainted with this disease. The new school is to be composed of men and women who are to make the prevention of disease the primary aim of their life work. There are four members of the National Academy of Sciences in the faculty of the School of Hygiene and Public Health.

At the close of the evening Dr. Hendrik Anton Lorentz, of the University of Leiden, was asked to speak and responded with characteristic geniality. He recalled his visit to the United States sixteen years ago and told how glad he was to accept the invitation of the Carnegie Institution of Washington and the California Institute of Technology, Pasadena, where he has been lecturing. Now on the eve of departure he expressed his gratitude for the kindness that had been showered upon him in various parts of the United States which was, he felt, more than he deserved and was, as he had discovered in some cases, due to the fact that he was taken for the Viennese surgeon, Dr. Lorenz. Everywhere he found earnest young men engaged in research which promised great things for the future of science in America. He found nothing to criticize, but took the opportunity of suggesting that perhaps the strenuous life and feverish activity of Americans might be benefited by somewhat of the Dutch restfulness of his own land.

EDWIN E. SLOSSON

THE EDWARD C. PICKERING MEMORIAL

THE wonders of the sky present such a fascinating appeal to the general public that large numbers of telescopes are sold each year to the amateur who with keen delight views the marvels of Saturn's rings, the everchanging appearance of Jupiter and his satellites, and the glories of the nebula of Orion. These and many other objects are observed with the greatest of eagerness, and books on descriptive astronomy are bought and are read with great avidity. The pleasures brought by the new telescope are all the more enjoyed if the instrument arrives during the summer season. Then it may be taken out into the garden or on to the roof top and the pleasure is unalloyed by biting winds, cold hands or freezing feet. With the coming of autumn and winter the telescope is used less frequently, and the warmer weather of spring and summer is looked forward to

with anticipation. (The writer of this article looks back with anything but the keenest of joy to working for thirteen hours at night at the Yerkes Observatory with the thermometer at twenty-six degrees Fahrenheit below zero). Very frequently the keenness of the astronomical thrills becomes gradually dulled, the small telescope has not sufficient power to show the more remarkable objects in the sky, clouds and cold weather interfere with observing—and soon the telescope is brought out but seldom, and finally is offered for sale.

Many of these amateur star-gazers might have had their interest continued if only their work at night could have had some object other than personal pleasure. The American Association of Variable Star Observers has been of very great value to astronomy by organizing the owners of two-, three-, four- or five-inch telescopes and showing them how they can cooperate with the professional astronomer using larger telescopes to observe the class of objects in the sky known as variable stars. As their name signifies, these stars vary in brightness, sometimes being bright, sometimes much fainter. There are more than three thousand of such stars known in the the sky. The variations of some stars like Betelgeuse, β Lyræ or δ Cephei can be followed by the naked eye, some of the stars at minimum brightness can be seen with a five-inch telescope, while others become so faint at minimum that they are almost or quite invisible in the largest telescope in existence. Some of these variables have a period from maximum to minimum which is quite short, measured by an interval of a few hours or a few days in length, some of the periods are measured in hundreds of days. Some of the periods are quite regular, some are very irregular. The well-known Algol changes in brightness by one component eclipsing the other. There are other stars like SS Cygni, V. Geminorum, and SS Aurigæ that are normally faint, and suddenly and for some reason for which as yet we have no adequate explanation greatly augment their brilliancy, the last of the three stars named above may increase its brightness one hundredfold in twenty-four hours. There are thus many varieties of variable stars most of which need careful and systematic observation, and consequently an observing program can be chosen which can be adapted to the aperture of the telescope used.

Largely through the enthusiastic efforts of Wm. Tyler Olcott of Norwich, Conn., the American Association of Variable Star Observers (or the A. A. V. S. O.) was organized in 1911 with seven observers. In ten years the membership has grown to three hundred, and the total observations made has the amazing number of 120,000. The present plan of the A. A. V. S. O. is that its members are observing systematically the changes in brightness of more than three hundred stars of long period. The stars under observation can be followed until with diminishing brightness they become invisible with the small apertures employed. These stars, however, can still be seen with telescopes of larger size in the hands of the professional astronomer. By a plan of cooperation, therefore, the members of the A. A. V. S. O. can observe the variables when bright while Harvard with its twelve or fifteen-inch telescope and the McCormick Observatory with its still larger aperture of twenty-six inches can observe when faint, and thus the stars can be kept under almost continual observation, except when the stars are too near the sun. Each month each observer sends his observations to Harvard College Observatory where the observations are collected together and are then published in *Popular Astronomy*. This immediate publication is of great value in keeping alive the interest of the amateur for each observer can see that his observations are of value in fixing the brightness of the stars and even the beginner can experience the thrill of finding that his observations perhaps fit in beautifully with the magnitudes determined by observers of greater skill.

Professor Edward C. Pickering, the late director of Harvard College Observatory, was keenly enthusiastic about the work of the A. A. V. S. O. for he recognized the very great value of this organization. And now to perpetuate its work and to increase its value to astronomy the Association of Variable Star Observers is asking for an endowment to bear the name, the Edward C. Pickering Memorial.

The income from this fund is to be entirely devoted to variable star research, none of it being required for "overhead" or for equipment. Through an arrangement with Professor Pickering's successor, Dr. Harlow Shapley, Harvard College Observatory is to put the second floor of its library building at the disposal of the A. A. V. S. O. for its offices, and is to allow the use of one of the domes on the observatory grounds to house the largest telescope owned by the association, that recently acquired through the generous gift of Mrs. C. A. Post of Bayport, L. I.

Professor Pickering was so well known to members of the A. A. A. S. and to readers of SCIENCE that it is felt that many will wish to contribute to such a worthy cause as the Edward C. Pickering Memorial. Contributions should be sent to Wm. Tyler Olcott, Norwich, Conn., or to Leon Campbell, Harvard College Observatory, Cambridge, Mass.

S. A. MITCHELL

J. D. MITCHELL

MR. J. D. MITCHELL died at Victoria, Texas, on February 27, 1922.

Some years ago when the writer was about to go to Texas for the first time, he made the rounds of a number of scientific offices at Washington to obtain such information as he could about the natural history of Texas. Wherever he went, whether to entomologists, ornithologists, ichthyologists or botanists, the same advice was given. That was to go to Victoria and see Mr. J. D. Mitchell. A man whose knowledge had made such a deep impression upon the leaders in several departments of science must certainly have been in some degree remarkable.

At Mr. Mitchell's house in Victoria he had large collections of animals of all classes. From day to day the house was visited by ranchmen, doctors, school children and others to ask about various points connected with natural history. Thus, technical men as well as persons from the ordinary walks of life were alike influenced by the learning of the man.

Mr. Mitchell lived for a good portion of his life on a cattle ranch on the coast of Texas. His love of natural history was inherited from his mother, who had extensive knowledge of the plants of Texas and their practical uses. Later he moved to Victoria where circumstances gave him an opportunity to devote most of his time to work on natural history. In 1904 he became connected with the Bureau of Entomology and made important contributions to several of the larger southern problems like those of the cotton boll weevil and the cattle tick. In fact, his pioneer work on the cattle tick was an important factor in the notable project of eradication which has now permanently removed the pest from more than three fourths of its original range in the United States.

Mr. Mitchell had no technical training. He was an example of the vanishing type of devoted naturalists who pursue the subject out of pure love for nature. He never described a new species. Although he collaborated on many publications of the Bureau of Entomology, he published only one paper, dealing with the poisonous snakes of Texas. Nevertheless, it is fitting that this note about his career should be published in this journal. He was a fountain of accurate information for technical men and was a modest, patient and painstaking imparter of knowledge. His life showed the enjoyment which comes from the contact with nature and was thus an inspiration to others.

W. D. HUNTER

HOUSTON, TEXAS

SCIENTIFIC EVENTS

ANNUAL TABLES OF CONSTANTS

THE confederation of French scientific societies has renewed for the year 1922 its contribution of 40,000 francs in support of Annual Tables. The total subscription in France to this project during the year 1921 was 80,000 francs.

At the approaching meeting of the International Union of Pure and Applied Chemistry which is to be held at Lyons in June, the matter of organizing the work of Annual Tables upon a solid financial basis will come up for consideration. This important international project has had a very precarious existence

since 1914 and the fact that the work has been continued at all has been due to the efforts of the general secretary, Dr. Charles Marie.

Plans for providing a certain and sufficient budget for the work during the next five years are in preparation, based upon definite annual contributions from the various countries in the International Union.

It is announced that the National Research Council of Japan has appointed the following advisory committee for Annual Tables: Yasuhiko Asahina, Eiji Aoyagi, Kotaro Honda, Katsuji Inouye, Gen-itsu Kita, Koichi Matsubara, Tsuruzo Matsumura, Seiji Nakamura, Kyoji Suyehiro, Umetaro Suzuki, Takuro Tamaru, Mitsumaru Tsujimoto, Nobuji Yamaga, Noboru Yamaguti. The chairman of the committee is Professor Yukichi Osaka, Japanese member of the International Commission in charge of Annual Tables.

ALASKA PENINSULA FISHERIES RESERVATION

UNDER date of February 17, 1922, an Executive order was promulgated creating the Alaska Peninsula Fisheries Reservation, extending eastward from the Aleutian Islands Reservation to a line from Foggy Cape, on the eastern end of Sutwik Island, to Cape Menshikof, on the northern shore of the Alaska Peninsula, and including the Shumagin Islands and the territorial waters adjacent to these lands and also the lands of the Aleutian Islands Reservation. The Secretary of Commerce is given power to make regulations for the proper administration of the newly created reservation and the waters covered by the executive order. The text of the order follows:

EXECUTIVE ORDER

In addition to the islands of the Aleutian Chain, Alaska, withdrawn and made a preserve and breeding ground for native birds, for the propagation of reindeer and fur-bearing animals, and for the encouragement and development of fisheries, by the executive order of March 3, 1913 (No. 1733), as modified by the executive order of August 11, 1916 (No. 2442), a reservation comprising the islands, peninsulas, and lands adjoining the eastern end of the reservation established by the said executive order of March 3, 1913, and extending in an easterly and northerly direction from Isanotski Strait to a line extending from low-water mark at Foggy Cape, on the eastern end of Sutwik Island, to low-water mark at Cape Menshikof, on the northern shore of the Alaska Peninsula, including the Shumagin Islands and all other islands, peninsulas, or parts thereof within the described area, is hereby set apart as a preserve to more effectively insure the protection of the fisheries and for their encouragement and development. This latter reservation is to be known as the Alaska Peninsula Fisheries Reservation.

It is hereby further ordered that all straits, bays, and other waters over which the United States has jurisdiction by reason of their relation and proximity to the islands, peninsulas, and other lands to which this order, as well as the said order of March 3, 1913, applies, be and the same are hereby reserved and set apart also as a preserve to more effectively insure the protection of the fisheries and for their encouragement and development.

The secretary of commerce shall have power to make regulations for the proper administration of the said Alaska Peninsula Fisheries Reservation, and the straits, bays, and other waters reserved by this executive order.

The establishment of the reservation under this executive order shall not interfere with the use of the waters, islands, or other lands for lighthouse, military, naval, or other public purposes, nor with the use of any of said islands or other lands under the laws of the United States for town-site purposes, mining purposes, or grazing of animals thereupon, under rules and regulations to be established by the secretary of the interior.

(Signed) WARREN G. HARDING

The White House, February 17, 1922.

A hearing was called for April 4 at the bureau's office in Seattle, when statements were received from those interested and information secured as a basis for regulations for the control of fishing in the Alaska Peninsula Fisheries Reservation.

THE FLORA OF PORTO RICO

DR. N. L. BRITTON, director in chief of the New York Botanical Garden, has returned from Porto Rico, after three months spent in an intensive study of the Porto Rican flora. Dr. Britton reports a very successful trip and the

collection of some 4,000 specimens. In addition to collecting plants and specimens for the garden, the object of the expedition was the obtaining of data for a flora of Porto Rico and the adjacent islands for publication by the New York Academy of Sciences, as parts of the scientific survey of Porto Rico and the Virgin Islands.

This survey was commenced in 1913 by the New York Academy of Sciences in cooperation with the insular Government of Porto Rico, the American Museum of Natural History, the New York Botanical Garden, the department of geology and of anthropology of Columbia University and with other American institutions. The work has been prosecuted since whenever practicable, but was much interrupted by the World War. In his report to the scientific directors of the garden, Dr. Britton says of the accomplishments to date in connection with the survey:

> The materials brought together already have formed the basis of numerous noteworthy contributions to knowledge, published by learned societies and by the cooperating institutions. Publication of the final reports was begun by the Academy in 1919, and three parts of the geological volumes and two of paleontology have now been issued, under the editorship of Professor R. W. Tower of the American Museum of Natural History. Additional parts of the geological volumes are now ready for the press, to be followed by those dealing with the botany and vegetable resources, the zoology, archeology and anthropology of the islands, as rapidly as funds for printing become available. The completion of the work will make the geology and natural history of Porto Rico and the Virgin Islands, insular possessions of the United States, the key to natural science knowledge of the West Indies.

The objects of the trip as detailed by Dr. Britton on his return were to supplement information about the vegetation obtained during several previous visits to the region and from the study of many specimens obtained by other collectors in former years; to ascertain now that the geological field work in Porto Rico has been completed, such distribution of species as may be governed by soils of different mineral composition, and to increase the representation of Porto Rican plants in the collections of the garden, with duplicates for exchange with other botanical institutions. These objects were satisfactorily accomplished, he says, over considerable areas of the island, special attention being given to the Northern and Southern Coastal Plains and to the higher mountain summits of the central districts.

EXPEDITION TO THE FIJI ISLANDS

A British government launch may be placed at the disposal of a party of scientific men from the University of Iowa who will be in the Fiji Islands on a collecting expedition during June according to a letter to Professor C. C. Nutting from Mr. T. E. Fell, acting governor of Fiji. Professor Nutting is head of the expedition which will sail from Vancouver on May 19 to the Fijis and New Zealand to gather laboratory and museum material for the university. Members of the party are: Professor R. B. Wylie, head of the department of botany; Professor A. O. Thomas, geologist; Professor Dayton Stoner, entomologist and ornithologist; Mrs. Dayton Stoner, who will assist in entomology; Waldo S. Glock, photographer and assistant geologist; and Professor C. C. Nutting, director of the expedition, whose specialty is marine invertebrates.

Arriving at Suva, Fiji Islands, about June 3, the party will be personally greeted by Governor Fell, who, as acting governor of Barbados at the time of the university's Barbados-Antigua expedition in 1918, extended many courtesies to the members of that party, which was also in charge of Professor Nutting.

The entire island of Makaluva, near Suva, has been placed at the disposal of the visitors, and the necessary buildings and equipment are conveniently at hand there. In addition to the launch the governor expresses his hope of having a small boat at hand for use in exploring the neighboring reefs, and arrangements are being made in advance for divers and reef experts to aid the party. All scientific equipment is to be admitted free of duty.

After remaining at Suva until early in July to make a study of Marine and tropical life, the

party will go to New Zealand, where animal and plant life and geological formations are of peculiar interest. The official secretary of New Zealand has written to say that everything possible will be done to make their stay in that country a success. It is expected that the return voyage will end in Vancouver about September 9 in time for the opening of the university.

THE SECTION OF MEDICAL SCIENCES OF THE AMERICAN ASSOCIATION

It may be of some interest, in this period of co-ordination, to know that at the Toronto meeting a group of parasitologists, medical entomologists and medical workers met and decided upon the following policy for Section N, Medical Sciences:

1. That it was extremely desirable and necessary that a closer co-ordination between parasitologists, entomologists and medical workers be worked out.

2. That the secretary of Section N (Medical Science), after consulation with the secretaries of the related societies, arrange for a program which will avoid conflicts with related groups.

3. That the secretaries of the allied societies, co-operating with the secretary of Section N (Medical Sciences), suggest those of its members who might be invited to take part in a symposium at which the significant researches are reported that are of interest to the allied groups of workers.

4. It was deemed undesirable to attempt for the present any formal co-operation between these related societies.

5. That the time has come when there is a definite need for the discussion of such papers as affect the interests in the allied groups, both for stimulation and for information.

6. That each secretary so arrange the papers of its society's program that it may be possible for its members to meet with Section N (Medical Sciences) without too serious a loss.

7. That the joint meeting be held under the auspices of Section N (Medical Sciences).

Section N (Medical Sciences) is proceeding with this policy on the assumption that such arrangements will in no way conflict with any program that may be adopted at the Washington conference, held under the auspices of the National Research Council.

A. J. Goldfarb,
Secretary.

THE BOCHER MEMORIAL PRIZE OF THE AMERICAN MATHEMATICAL SOCIETY

The American Mathematical Society announces the foundation of a prize in memory of the late Professor Maxime Bôcher, of Harvard University. Soon after the death of Professor Bôcher, in 1918, a fund was raised in his memory through the efforts of Professor T. S. Fiske, of Columbia University, which was turned over to the American Mathematical Society. On recommendation of a committee of which Professor E. B. Van Vleck, of the University of Wisconsin, was chairman, the council of the society has decided to devote the interest of this fund to the establishment of a prize, to be called the Bôcher Memorial Prize, and to be awarded at five year intervals, for a notable research memoir published in the *Transactions of the American Mathematical Society* during the preceding five years by a resident of the United States or Canada. The age of the recipient shall not be over forty years, and the prize shall not be awarded twice to the same person. The first award (of $100) is to be made for a memoir published during the period 1918-1922, and will be conferred at some meeting of the society in 1923.

This prize, which is believed to be the first mathematical prize to be given in this country at regular intervals for research in pure mathematics, is an especially appropriate memorial for Professor Bôcher, not only because of his achievements in research, but also because of his great services to mathematics in this country as one of the founders and for many years one of the editors of the *Transactions of the American Mathematical Society;* for this latter reason the provision that the prize must be awarded for a memoir published in the *Transactions* seems particularly appropriate.

SCIENTIFIC NOTES AND NEWS

AT the meeting of the National Academy of Sciences, held in Washington on April 26, members were elected as follows: Edward W. Berry, professor of paleontology, the Johns Hopkins University; George K. Burgess, Bureau of Standards; Rufus Cole, director of the hospital of the Rockefeller Institute for Medical Research; Luther P. Eisenhart, professor of mathematics, Princeton University; Joseph Erlanger, professor of physiology, Washington University Medical School; Herbert Hoover, secretary of commerce; George A. Hulett, professor of physical chemistry, Princeton University; Charles A. Kofoid, professor of zoology, University of California; George P. Merrill, curator of geology, U. S. National Museum; C. E. Seashore, professor of psychology, State University of Iowa; Charles R. Stockard, professor of anatomy, Cornell Medical College; Ambrose Swasey, president of the Warner and Swasey Company; W. H. Wright, astronomer, the Lick Observatory, University of California. Dr. Albert Einstein, of the University of Berlin, was elected a foreign associate.

AT the meeting of the American Philosophical Society, held in the city of Philadelphia, on April 23 and 24, the following officers were elected: *President,* William B. Scott; *vice-presidents,* Arthur A. Noyes, Hampton L. Carson, Henry Fairfield Osborn; *secretaries,* Arthur W. Goodspeed, Harry F. Keller, John A. Miller; *curators,* William P. Wilson, Henry H. Donaldson; *treasurer,* Eli Kirk Price; *councillors,* Lafayette B. Mendel, Herbert S. Jennings, William W. Campbell, Robert A. Millikan, Felix E. Schelling. Members were elected as follows: Charles Elmer Allen, Madison, Wis.; Rollins Adams Emerson, Ithaca; Worthington C. Ford, Cambridge, Mass; Frederick E. Ives, Philadelphia; Irving Langmuir, Schenectady; Roland S. Morris, Philadelphia; George William Norris, Philadelphia; Charles Lee Reese, Wilmington; Harlow Shapley, Cambridge, Mass.; Henry Skinner, Philadelphia; James Perrin Smith, Palo Alto; Charles Cutler Torrey, New Haven; Robert De Courcy Ward, Cambridge; Henry Stephens Washington, Washington; David Locke Webster, Stanford University.

DR. WILLIAM F. OSGOOD and Dr. George D. Birkhoff, professors of mathematics at Harvard University, have been elected corresponding members of the Göttingen Academy of Sciences.

AT the anniversary meeting of the Royal Irish Academy held in March, Professor T. H. Morgan, of Columbia University, and Professor Jules Bordet, of the University of Brussels, were elected honorary members in the section of science.

THE Entomological Society of Brazil, on March 9, elected Dr. W. J. Holland, director of the Carnegie Museum of Pittsburgh, as one of its honorary members "in token of their appreciation of the services he has rendered to the science of entomology."

PROFESSOR W. NERNST will take over on April 1 the duties of director of the Physikalisch-Technische Reichsanstalt, but will continue to act as rector of the University of Berlin until October 15.

PROFESSOR DUGALD C. JACKSON, head of the department of electrical engineering, Massachusetts Institute of Technology, was elected president of the Boston Society of Civil Engineers at the annual meeting of the society on March 15.

DR. T. WAYLAND VAUGHAN has at his request been relieved of administrative duties as chief of the Coastal Plain section in the Geological Survey, and L. W. Stephenson has been assigned these duties. W. P. Woodring has been appointed chief of the section of West Indian geologic surveys in the Coastal Plain section.

F. J. KATZ, who has been with the Census Bureau for several years, has returned to the Geological Survey and will be assistant chief of the Mineral Resources section.

HERBERT POPENOE, of Stanford University, has been appointed psychologist for the California State Bureau of Juvenile Research, to be stationed at the Preston School of Industry.

F. H. READ, formerly assistant engineer of tests of the Pittsburgh Testing Laboratory, has resigned to accept the position as research engineer of the Office of Public Roads, with headquarters at Harrisburg, Pa.

THE Smith's Prizes at the University of Cambridge have been awarded to E. A. Milne, Trin-

ity College, for an Essay on "Studies in the theory of radiative equilibrium," and to G. C. Steward, Gonville and Caius College, for an Essay on "The Aberration-diffraction problem." J. A. Carroll, Sidney Sussex College, has been elected to an Isaac Newton Studentship, and the studentship of W. M. H. Greaves, St. John's College, has been prolonged for a year.

THE American Medical Association has granted to Dr. Reynold A. Spaeth, of the Department of Physiology, School of Hygiene and Public Health, Johns Hopkins University, the sum of $200 to further his researches on the relation between susceptibility and fatigue.

DR. W. A. CANNON, of the Department of Botanical Research of the Carnegie Institution of Washington, has returned to this country from South Africa where for several months he was engaged in making observations on the plants and on the conditions of plant life in certain of the more arid portions of that country.

PROFESSOR LAZARUS BARLOW, who holds the chair of experimental pathology at the Middlesex Hospital Medical School, is visiting the United States to investigate methods of cancer research and radium treatment.

PROFESSOR ALEXANDER MAXIMOFF, formerly professor of histology and embryology at the Imperial Academy, Petrograd, has arrived in Chicago from Russia to accept an appointment in the department of anatomy at the University of Chicago.

ON February 19 Dr. Francis W. Simonds completed thirty-two years of continuous service as head of the department of geology in the University of Texas. Dr. Simonds is now the senior professor in the faculty of the College of Arts and Sciences, and for the past five years he has been secretary of the general faculty.

THE University of Buffalo recently combined with Canisius College and the Buffalo Society of Natural Sciences in bringing Professor M. M. Metcalf, formerly of Oberlin College, to Buffalo for a series of three lectures on "Animal Distribution; Man's Origin; Man's Future: can he control it?" The lectures were given on April 26, 27 and 28, and the course was attended by about 3,500 people.

PROFESSOR C. J. KEYSER gave, on April 20, a lecture before the Detroit Mathematics Club on the mathematical obligations of philosophy and education.

FREDERICK V. COVILLE, botanist of the Bureau of Plant Industry, delivered the annual address before the Gamma Sigma Delta fraternity of the Kansas State Agricultural College on April 26. His subject was the "Influence of cold in stimulating the growth of plants." While in Manhattan, Mr. Coville visited the station projects and lectured before the staff members on "Acid tolerant plants" and related subjects.

SIR ERNEST RUTHERFORD delivered a Royal Institution lecture on April 7, on "The evolution of the elements."

GEORGE BRUCE HALSTED, professor of mathematics at the University of Texas from 1882 to 1903 and subsequently at the State Teachers College, Greeley, Colorado, died in New York City on March 19, at the age of sixty-nine years.

DR. ANSEL A. TYLER, professor of biology in James Millikin University, died of pneumonia on Friday, March 31. Dr. Tyler was born in East Bridgewater, Pa., in 1869. He did his undergraduate work in Lafayette College and received his Ph.D. from Columbia University. He had served on the faculties of Union College, Syracuse University; University of Arizona; and Bellevue College, Omaha.

HENRY NEWTON DIXON, formerly lecturer in the Oxford School of Geography and professor of geography in University College, Reading, has died at the age of fifty-six years.

PHILIPPE AUGUSTE GUYE, professor of physics at Geneva, died on March 27, at the age of sixty years.

PROFESSOR HEYN, whose work at the Materialprüfungsamt, first under Martens and later as co-director, has made his name known to engineers and metallurgists, has died at Berlin at the age of sixty-eight years.

THE death is announced of Professor Robert Wenger, director of the Geophysical Institute of

the University of Leipzig.

BY the will of the late Professor E. C. Hansen, of Copenhagen, a prize has been founded to consist of a gold medal and a sum of at least 2,000 crowns, to be awarded every two or three years for distinguished work in microbiology, published within the preceding years in Denmark or elsewhere. It is proposed in 1922 to confer the medal on some worker in general not medical microbiology. The foundation is in charge of the chiefs of the Carlsberg Laboratory at Copenhagen. Professor C. O. Jensen and Professor S. P. L. Sörensen, Professor Calmette of Paris and Professor Theobald Smith of Princeton are also on the committee of awards.

A CONFERENCE of those who teach physiology in the women's colleges of the northeast was held at Mount Holyoke College on April 21 and 22. The conference had to do almost entirely with teaching problems, since there have been very few opportunities for such discussions at the usual scientific meetings. Among the topics were the aims of the courses given at the various institutions, the prerequisites and content of the courses, the choice of material for experimental purposes, the affiliations of physiology with chemistry, physics, zoology and hygiene, and the type of research possible with undergraduates. The institutions represented were Barnard, Bryn Mawr, Connecticut, Goucher, Mount Holyoke, Simmons, Smith, Vassar and Wellesley.

WILLIAM WOOD & Co. have transferred publication of the New York *Medical Record* to the A. R. Elliott Advertising Agency, which publishes the *New York Medical Journal* and the *American Druggist*. The *Medical Record* was first issued in March, 1866. Dr. George F. Schrady was editor of the journal from its inception until his death in November, 1907, since which time it has been under the editorial management of Dr. Thomas L. Stedman.

THE publication of the *Behavior Monographs* will be discontinued upon the completion of the current volume (Volume 4) and a new series of Comparative Psychology Monographs will be initiated under the editorship of Professor Walter S. Hunter, of the University of Kansas, with the cooperation of Professor H. A. Carr, of the University of Chicago, Professor S. J. Holmes of the University of California, Professor K. S. Lashley, of the University of Minnesota and Dr. R. M. Yerkes, of the National Research Council. The new monograph series will be broader in scope than the old and, in addition to studies in animal behaviour, will publish work in human psychology conducted from the comparative point of view.

THE Permanent Bureau of All-Russian Entomo-Phytopathological Congresses, Petrograd, desires: (1) To exchange printed matter (published since 1914) on entomology, phytopathology, mycology and zoology, with American colleagues, scientific societies, agricultural experiment stations, museums of natural history, periodicals, etc.; (2) To receive from American publishers catalogues and specimen numbers of various publications on the above mentioned subjects; (3) to receive catalogues and price lists from American firms dealing in apparatus and chemicals used in combating plant enemies. Mr. D. N. Borodin will forward packages of books, bulletins, etc. for Russia, addressed to him at No. 110 West 40th Street, New York City.

THE Kelp-Potash Plant of the Bureau of Soils, U. S. Department of Agriculture, at Summerland, California, was sold and transferred on April 1 to Mr. Rodney Benson of Santa Barbara. This plant was constructed in 1917 and operated for four years as an experimental and demonstrational plant with a view to the development of processes for extracting potash and by-products from the giant kelps of the Pacific. It was closed through Congressional action in 1921. The plant will be enlarged and put back into operation at once for the manufacture of "Kelpchar" (a decolorizing carbon of very high activity), potash salts, and iodine. Dr. J. W. Turrentine, who was in charge of the plant throughout the period of the experimentation, after turning over to the Government's successors the manufacturing data established there, will return to Washington, D. C.

THE *Journal* of the Washington Academy of Sciences reports that Dr. T. T. Waterman, lately

appointed ethnologist of the Bureau of American Ethnology, has left for field-work in Alaska, Oregon and Washington. He will first proceed to the Kasaan National Monument, Alaska, to study the architecture, totem poles and other objects at this village and will be accompanied by a half-breed Haida, related by marriage to Chief Skoul. It is expected that considerable legendary data bearing on history and sociology of the former inhabitants of Kasaan will also be collected. Should the results justify further work it is planned to continue field-work on place names and aboriginal village sites of Alaska to be followed later by work on stratigraphic archeology in more northern latitudes in order to discover if possible traces of the oldest Indians in this supposed prehistoric gateway of the migration of man into North America.

ACCORDING to the correspondent of the Associated Press, boring into the crater of Kilauea, the active volcano on the Island of Hawaii, will be started May 1 in an effort to ascertain the heat underground and to discover whether it can be turned into industrial channels. A contract has been signed and the work, which will consume approximately six months, will be under the direction of Professor T. A. Jagger, volcanologist, in charge of the Kilauea observatory. Holes will be bored to various depths on all sides of the Kilauea crater, the great Kau desert to the south and at accessible spots on the floor of the crater. It is planned to bore into the lava flows of 1921, 1919, 1918, 1894, and in some more ancient flows, to ascertain whether any of the heat generated by those disturbances remains underground.

THE Collins collection of algæ, covering both the seaweeds and their fresh-water relatives, has recently been acquired for the herbarium of the New York Botanical Garden in Bronx Park through the generosity of its director-in-chief, Dr. N. L. Britton. The new accession includes more than 40,000 specimens from nearly all parts of the world, New England, Bermuda, Florida, California, Alaska, the Philippine Islands, Japan, the Dutch East Indies, South Africa, Australia and the South Sea Islands being especially well represented. Frank Shipley Collins of Malden and later of North Eastham, Mass., was a business man who devoted his leisure to the advancement of scientific knowledge. The Collins collection is the latest of an importnt series of large collections which have been purchased to facilitate the scientific researches that are carried on in the Bronx Park institution. Among these are the J. B. Ellis collection of fungi, numbering about 80,000 specimens; the Mitten collection of mosses and hepatics, including about 50,000 specimens; the Underwood fern collection, with 16,000 specimens; the Otto Kuntze herbarium of more than 30,000 miscellaneous specimens, presented to the Garden by the late Andrew Carnegie; the Vigener herbarium of more than 20,000 specimens, also presented by Mr. Carnegie; the A. Henry collection of Chinese plants, including nearly 8,000 specimens, and the Jenman collection of West Indian and South American ferns, comprising about 4,000 specimens and given by the late D. O. Mills, the first president of the Board of Managers of the New York Botanical Garden. The number of specimens in the entire herbarium of the garden is now approaching 2,000,000 .

THE ninth annual Faculty Research Lecture at the University of California by election by the Academic Senate was given by Dr. Charles A. Kofoid, professor of zoology in the university who spoke on Charter Day, March 22, on "Amœba and man." The discovery was announced of the detection of amœba in the bone marrow in cases of Ely's second type of arthritis deformans in man. The amœbic nature of the parasites in the bone lesions was demonstrated by their mode of cell division and the number of chromosomes which differ from those of human cells.

THE correspondent of the London *Times* at Paris, under date of February 15, writes that the solemn reception of Mme. Curie by the Academy of Medicine is a *fait accompli*. The secretary-general read the terms of the decree by which the president of the republic approved the election of Mme. Curie. As an unprecedented mark of honor, M. Béhal made a speech to welcome the first *Académicienne*. He reminded her that it was about twenty years ago that, in response to his request, she gave a lecture at the Sorbonne on radium, which she

had discovered, and was studying with her husband, Pierre Curie. He rapidly reviewed the ground traveled since then, and continued: "All these discoveries which result from yours are as nothing compared with the fundamental fact which you found—I mean the formidable energy contained in the atomic system. If we are to succeed in being able to release it methodically it would relieve the world from the dread of seeing disappear, at short notice, reckoning time in relation to the age of the world, the fuel accumulated in former centuries which is at present our principal source of energy." Mme. Curie bowed low and took her seat simply and without a word among her eminent colleagues.

DR. LYNDS JONES, from the department of animal ecology of Oberlin College, is arranging a special field expedition to leave Oberlin on June 23, going west through Illinois, across the Mississippi to Iowa and on toward MacGregor, through Southern Dakota, across the Big Horn Mountains in Wyoming into Yellowstone Park. The itinerary will then take the party to Pocatelo, Idaho, on to Salt Lake City and southern Utah, visiting the National Mountains and Bryce's Canyon. Leaving Utah, the group will strike across the northern part of Arizona and the southern tip of Nevada into southern California. Proceeding to the coast a week's camp will be made near San Diego. Sixteen students will make up the party, traveling with automobiles with complete camping outfit. Special attention will be given to the study of bird and animal life and field maps and topographical surveys will be prepared covering all parts of the route.

THE Department of Commerce will send a party, headed by Assistant Secretary C. H. Huston, to Alaska this summer for the purpose of making a general investigation of conditions in which that department is particularly interested. The Bureau of Fisheries, the Coast and Geodetic Survey, the Lighthouse Service and the Steamboat Inspection Service are the bureaus of the department which are closely identified with the affairs of the territory. It is the purpose to determine in what ways these bureaus can be made of greater benefit in developing Alaska. Particular attention will be devoted to the salmon fisheries, which yield products of an average annual value of about $40,000,000 and in normal seasons give employment to upwards of 20,000 persons and represent an investment of about $70,000,000. It will be the purpose also to observe conditions in respect to the fur-seal industry at the Pribilof Islands, which work is administered by the Department of Commerce through the Bureau of Fisheries.

UNIVERSITY AND EDUCATIONAL NOTES

THE *Journal* of the American Medical Association states that ground was broken on April 10 for a new building which will accommodate the departments of botany, zoology, pharmacology and physiologic chemistry at Tulane University of Louisiana School of Medicine, New Orleans. The building is to be four stories high and will be erected at a cost of about $180,000, $125,000 of which has been subscribed by the general education board. The laboratory will be equipped at a cost of $30,000 and it is expected that the institution will be completed in December.

DR. WARFIELD THEOBALD LONGCOPE, Bard professor of medicine at Columbia University, and physician in chief at the Presbyterian Hospital, New York City, has been appointed professor of medicine at the Johns Hopkins University Medical Department, and physician in chief at the Johns Hopkins Hospital, beginning on July 1, when the one-year term of Dr. H. Canby Robinson will expire. Dr. Robinson went to the hospital with the understanding that at the end of one year he was to return to his post as professor of medicine and dean of the Vanderbilt University Medical Department.

PROFESSOR CHARLES L. NORTON, head of the division of cooperation and research at the Massachusetts Institute of Technology, will become head of the department of physics, vacant by the acceptance by Professor E. B. Wilson of a call to the Harvard School of Public Health.

BENJAMIN BRITTON GOTTSBERGER, who since 1920 has been a consulting engineer with offices

in New York City, has been appointed professor of mining in Yale University to succeed Professor James F. McClelland who resigned in 1919.

AT the New York Post-Graduate Medical School and Hospital, the laboratory of pathological chemistry, formerly a division of the department of laboratories, has been made an independent department and the name changed to the department of biochemistry. The personnel consists of Victor C. Myers, Ph.D., professor and director; Cameron V. Bailey, M.D., and John A. Killian, Ph.D., assistant professors; Hilda M. Croll, M.A., associate and Herbert W. Schmitz, M.D., assistant.

DISCUSSION AND CORRESPONDENCE

THE FUTILITY OF THE HUMAN YOLK SAC

IN the current issue of the *Anatomical Record*, Professor Arey publishes a brief but very interesting contribution (No. 90) from the Anatomical Laboratory of Northwestern University. He describes a human chorion containing two embryos, of 11.5 and 12 mm. respectively, one of which has a yolk sac, and the other has none—that is, none was found, and sections of the umbilical cord showed no trace of a yolk stalk. Hence the broad conclusion is drawn that "the human yolk sac is a vestige unessential to growth or differentiation (including vasculogenesis)." It is stated that one of these embryos "received all, or essentially all, the cells destined to form a yolk sac" and that "the total absence of a yolk sac in one embryo, which is otherwise normal in every way, further demonstrates conclusively that this organ is not essential to the growth of an embryo or to the proper differentiation of its parts; indeed, the embryo in question is slightly larger than its twin."

Since from the days of Wolff the yolk sac has been regarded as the source of the intestinal tract, and in young human embryos is seen to be the organ from which the allantoic duct and the digestive tube proceed, the startling nature of this conclusion becomes apparent. But it is universally recognized that the yolk sac does its work in early stages, and though the sac usually persists as a functionless rudiment until birth, its duct normally becomes parted through atrophy in embryos younger than the one under consideration. Does Dr. Arey's case indicate anything more than the precocious obliteration of the stalk of an organ no less essential than the placenta, likewise cast off after its very vital functions have been performed?

If the question is raised, Where then is the yolk sac in Dr. Arey's case? his own studies furnish a plausible answer, since in another specimen he has described a single sac with two stalks, each leading to a separate embryo. Under such circumstances, the early obliteration of one of the stalks would give rise to the conditions observed in the second case, and this possibility must be eliminated before accepting the proposed conclusion. In reading the account of a human embryo without a yolk sac, we recall Bentham's incredulous comment, "I am very glad, my dear sir, that *you* saw that, for had I seen it myself, I wouldn't have believed it."

FREDERIC T. LEWIS
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DEFLECTION OF STREAMS BY EARTH ROTATION

THE recent note by Professor Jennings suggesting that the steeper valley sides on the right of the south-flowing streams on Long Island may be due in some manner to wind action instead of to the deflective effect of the earth's rotation is a welcome contribution to an old problem. In spite of Gilbert's apparent acceptance of the earth's rotation in explanation of the unsymmetrical cross-section of those valleys, the small size of their streams has always stood in the way of it, all the more since Bowman showed, on the basis of accurate maps of the lower Mississippi, that even that great river shifted its course to the east or left, apparently under the control of the wind, and not to the west or right, as it should if the earth's rotation were in control.[1]

[1] SCIENCE, XX, 1904, 273-277.

It is, however, interesting to note that the remarkably well defined right-handed or eastward shifting of many radial streams that flow down the gentle slope of the great alluvial fan, known as the plateau of Lannemezan, at the northern base of the Pyrenees—beautifully shown on the 1:80,000 map of France, sheets 216, 217, 227, 228, 229, 239, 240, and 241—has been explained by Marchand and Fabre[2] not as a consequence of the earth's rotation but as a result of stronger action of rain driven by westerly winds; so that here it is the valley sides facing against the wind that are the steeper, while on Long Island the steeper valley sides face with the winds. It is difficult to understand just how either explanation works, but in any case the relation of the steep valley sides and the prevailing winds is unlike in the two examples.

W. M. DAVIS

CAMBRIDGE, MASS.,
APRIL 2, 1922

POSSIBLE CAUSE OF THE RED COLOR OF POTASH SALTS

THE red color of certain potash and ordinary salt deposits has been observed in many parts of the world, for example, in the Indian, German, Alsatian and Spanish potash deposits, in Nova Scotia, west Texas and doubtless in other places that the writer has not heard of. The same, though a less intense coloration has been observed by the writer in the surface salt and strong brine standing in the trenches and in pools along the margin of the salt ponds where solar salt is made along the shore of San Francisco Bay, California. It has been noted at Searles Lake in the same state. I am told that the same red color exists also in the solar salt ponds on Turks Island. It is undoubtedly of common occurrence in many places where solar evaporation results in producing salt, either naturally or artificially.

The red color associated with certain potash minerals is so common that it has come almost to be regarded as a means of identifying certain of them, for example, the mineral carnallite in the German deposits. There is however, as chemists well know, nothing inherent in the composition of carnallite ($KCl.MgCl_2.6H_2O$) to cause this red tint and indeed the normal color of the pure double salt should be the same as that of ordinary white rock salt.

There has been a great diversity of opinion as to the origin of the red color in solar salt and bitterns where solar evaporation is in progress. That it is not necessarily due to the presence of iron appears evident from the observations of George Lunge, the expert on sulphuric acid manufacture. Lunge[1] states that:

> The red color exhibited by many alkaline salt lakes, which is often also apparent in the salt deposits, is ascribed by Payen[2] to the presence of small crustaceans, *Artemia Salina* Leach (*Cancer salinus* Linné), which appear in large masses when the water has attained a density of 1.16, and which are of a gray or greenish color; on further concentration to a specific gravity of 1.21, they die and form a red froth at the surface. . . . I, for my part, must decline to accept the assumption that the red color is regularly caused by the presence of *Artemia* or other animal organisms, if it is ever due to that cause; for the samples of red water which I had myself taken from the lakes of the Wade Atrun have preserved that color during the many years I have kept those samples. The red filtrate shows nothing under the miscroscope; the color is at once discharged by adding nitric acid or hypochloride and hydrochloric acid and is evidently caused by organic substances present in solution. There is no iron present.

Recent studies made in the U. S. Bureau of Fisheries, Department of Commerce, connected with the reddening of salt fish are of interest and importance in this connection. They are also of economic value in view of the considerable annual losses to the fish industry caused by salt fish developing a red color when stored under moist conditions. The Bureau investigations, which were conducted by W. W. Browne[3],

[2] Les érosions torrentielles et subaériennes sur les plateaux des Hautes Pyrénées. *C. R. Congr. Soc. savantes*, 1900.

[1] Lunge, Geo., *Sulphuric Acid and Alkali*, Vol. 2, pt. 1, p. 58, 1909.

[2] Payen, Anselme, *Annales chim. et phys.*, 2d ser., Vol. 65, p. 156, 1837.

[3] Bureau of Fisheries, Document 896, 1920, pp. 27-28.

indicate that the red color is due to two microorganisms, which probably originated in the sea salt used in curing the fish. The color varies from pale pink to deep crimson, the former the result of the growth of a spirochete, and the latter produced by a bacillus form.

These microorganisms grow in completely saturated brine on salt fish and on salt piles, but no growth appears in media containing less than 15 per cent. of salt by weight. The most favorable temperature for the growth of both organisms is between 50° and 60° C. indicating that the salt lagoons of the tropics are probably sources of infection. Sunlight is not germicidal, which also points to their tropical origin where pigmentation is required against bright sunlight. Ordinary bacteria are killed by ten minutes exposure to the bright sunshine. Salt acts as a preservative preventing the growth of most organisms, but here is an instance of just the opposite effect.

In summary, the results of recent investigation indicate that the cause of the red color in solar salt and brine is due to organisms as indicated above and that their source is salt produced by solar evaporation. Both European and American sea salt is infected, but mined salt is free from their presence.

The studies made by the Bureau of Fisheries and by others before it (See Bibliography published by Bureau of Fisheries) have suggested to the writer that possibly causes allied to those now producing red coloration in solar salts may have been active as long ago as the Permian. Whatever may be the main cause of the reddening of the Permian potash salts, the question naturally arises, is the reddening in the potash salts of the German Permian, the Alsatian Oligocene and the Spanish Tertiary deposits due to the same or similar agencies that are causing reddening in the solar salt of the present time. It is probable that both types of salts have been formed under essentially similar conditions, that is, salt pan conditions. If this last statement be admitted, then it points to the growth of bacteria, at least intermittently, from the Permian down to the present.

This is presented to induce further study along this line and to elicit discussion and opinions. Such studies may also throw some light on temperatures during Permian and later geologic time.

W. C. Phalen,
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POPULAR SCIENCE

To the Editor of Science: I am sorry to see that Dr. E. Dorsey confirms[1] the opinion expressed by Dr. Brooks[2] and myself[3] that science is relatively losing ground in popular interest and esteem. I fear he is right also in saying that this is in part the fault of scientists. For the prevalent indifference and even hostility of the public to the higher teachings of science may be matched by the indifference and even hostility of certain scientific men to the "vulgarisation of science."

It is quite true, as Dr. Dorsey points out, that isolated facts, however numerous and authentic, do not constitute science. I have kept that point in mind in all our Science Service work. For instance I said in a recent magazine article:[4]

> We can get from the reading of science not only new things to think about, but, what is more important, new ways of thinking about things.

But I hope that Dr. Dorsey will not discourage those of us who are trying to get a larger amount of "mere information" in the newspapers. A few more facts are really needed to season the mass of fiction there. We may also hope to get over some idea of the relations between facts and how the scientist finds his facts and what he gets out of them. But we can not expect that the newspaper reader will acquire the habit of persistent experimentation, constant criticism, rigorous reasoning, projection of hypotheses, balancing of theories and suspension of judgment characteristic of the scientific mind. If the layman

[1] Science, 55: 374, 1922.
[2] *Journal Washington Academy of Sciences*, 12: 73, 1922.
[3] Science, 55: 241, 1922.
[4] "Science from the Side Lines," in *The Century*, January, 1922.

could get all this he would be not a layman but a scientist. The most we can expect is that the layman may gain sufficient acquaintance with scientific thinking to understand the methods and aims of research and to appreciate its value to civilization. That he does not commonly acquire such comprehension and appreciation is because the men who understand the value of science have been too often unwilling to take the pains to impart their information and inspiration to him.

We are told that Agassiz required of his students in every department to prepare "first a monograph, second a scientific lecture, third a popular lecture, fourth a simple child's tale." How many of our annual army of Ph.D.'s would pass the third and fourth of these intelligence tests? Agassiz had his reward in the dozens of devoted disciples who became the teachers of the next generation and in the thousands of young people who bear his badge as they search forest and strand with curious eyes. But we need more men of the Agassiz type—and we seem to be getting fewer.

England, as I showed in SCIENCE, seems to have more men of high standing who are willing and able to translate their learning into the vernacular. It would be hard to match in all America the popular lecturers of the Royal Institution from Faraday to Bragg. But even in England we hear complaints of the growing gulf between the specialist and the public. The once-popular lectures to workingmen are now said to be running short of both speakers and hearers. Last year the columns of *Nature* were filled for months with discussions of why the lay membership of the British Association for the Advancement of Science was falling off. The British Association has always had the advantage of ours in the large number of citizens, not professionally engaged in scientific pursuits, who would support and attend the annual meetings but now it is becoming, like the American Association, a congeries of highly specialized sections.

Several of the correspondents in *Nature* expressed the opinion that the public had lost interest and confidence in science because scientists have lost their fighting spirit and the courage of their convictions. They take everything lying down nowadays and do not dare to defend their views or even defend their right to hold and teach their views.

This is a point worthy of consideration by those American men of science who have adopted the policy of treating with dignified contempt the present legislative and ecclesiastical attacks upon their intellectual freedom. Little is being done in scientific circles to check the rising tide of superstition and intolerance now sweeping over the land. Perhaps when appropriations are cut off, as in South Carolina, on the ground that the university has an evolutionist on the premises our scientific pacifists may sharpen up their pens and turn out literature as interesting to the general reader as Huxley's debate with Gladstone about the demons who converted the pigs of Gadara into pickled pork.

Dr. Dorsey is wise in putting "accounts of discoveries" first in his list of popular science subjects. But who will write them? I have been hunting in vain for writers who could sense the dramatic elements in such a scene as Archimedes' bath and tell how this ancient graft case led to the law of specific gravity. Who will describe the feelings of Faraday when he saw the loose end of a little magnet rotating about an electric wire in the dingy laboratory of the Royal Institution and then explain what that had to do with the trolley cars that are passing in the street?

The history of science is as rich a field for the cultivation of good literature as the history of literature, art and music but it remains untilled for want of attention. Students have been trained to look another way. The aim is now to eliminate the personal element from science and reduce it to an abstract and timeless formula. This may be necessary as a scientific method but it naturally results in the decline of interest. The old textbooks are more readable than the modern. A distinguished physicist, in discussing this point with me, said: "When I was in college I had to study Hastings and Beach but I read Deschanel for my own amusement." I am not advising that our textbooks should return to the leisurely literary style of long ago but we can not expect depersonalized science to be popular. Whatever is without "human interest" is not interesting to humanity. Dehydrated potatoes

are convenient for conveyance but they have to be soaked up before they are palatable.

EDWIN E. SLOSSON

SCIENCE SERVICE
WASHINGTON

SCIENTIFIC BOOKS

An Introduction to Cytology. By LESTER W. SHARP. McGraw-Hill Book Company, New York, 1921. 452 pages, 159 illustrations.

For a subject of such wide interest and great significance as cytology, there are surprisingly few text books. For years Wilson's classic work, "The Cell in Development and Inheritance," has been the chief reference volume, especially of the beginning investigator. Very recently two English texts, one by W. E. Agar, "Cytology, with Special Reference to the Metazoan Nucleus," and another by L. Doncaster, "An Introduction to the Study of Cytology," have appeared. These are good books, dealing in both cases, however, with a rather limited field and largely with animal material. There has long been felt the need for an introductory text which would present an outline of the subject in both its botanical and zoological aspects. The rapid advances made by numerous investigators, working upon a great variety of materials, and the intimate relation of these in many cases to equally rapid developments in the other new science of genetics, have made the writing of a cytological text book a very difficult matter.

Professor Sharp, despite these obstacles, has done an excellent piece of work for he not only covers the fields of botany and zoology, but embraces in his consideration of subjects most of those necessary for an understanding of the scope of cytological knowledge. Very properly, however, he places emphasis upon the topics of greatest general interest. We find, therefore, that of the 452 pages of text, 240 are devoted to the hereditary mechanism and the results of its operation. Zoologists, particularly, will welcome so comprehensive a summary of the achievements of their botanical fellows as Professor Sharp presents. While this is naturally the strong part of the work, zoological material is well considered. Indeed, the author deserves special commendation for the completeness and fairness with which the contributions of zoologists are treated. In view of the general excellence of the book in this respect, it might be permitted, in the interest of the accuracy for which the author very evidently strives, to point out that in a few cases he has allowed his personal studies to influence his presentation of topics concerning which there are differences of opinion. Perhaps the most conspicuous example of this is in the discussion of the differential structure of the chromatin thread. While there may be uncertainty on this point in plant material, there is none in many animal forms.

The method by which the material is presented is entirely to be commended. In recognition of the developmental stage of the subject, Professor Sharp has endeavored to set forth its status by showing what the problems are and how they are being met, rather than by attempting to define in categorical terms the content of our knowledge. The spirit and motives of an investigation are as important as its achievement, and, since cytology is now so largely a matter of discovery, it would be a misrepresentation to exhibit it otherwise than as an active field of research.

As practical measures for such a presentation it may be noted that the numerous illustrations are, almost always, copies of those found in research papers instead of those from text books; extensive bibliographies follow each chapter, offering the means for a comprehension of the extent of the work done and for following up any particular subject;[1] there is a full index in which may be found the taxonomic position of all materials discussed; scattered through the chapters are brief historical or critical reviews of nomenclature; there are frequent diagrammatic figures which

[1] As indicating the scope and character of these references it may be noted that at the end of Chapter XI, "The Reduction of the Chromosomes," a total of 170 individuals, of 11 nationalities, are quoted. The distribution of these biologists is interesting, indicating, as it does in a general way, the interest in cytology exhibited in different countries. Of the 170 individuals referred to, there are 54 Americans, 46 Germans, 26 British, 13 French, 9 Japanese, 7 Scandinavians, 6 Belgians, 4 Hollanders, 2 Russians, 2 Italians, and 1 Pole.

present concisely the essential steps in the processes under consideration. These, with other features, make the book very accessible and helpful. It might here be suggested that the diagrams would be improved by larger index characters, and that somewhere a concise index to the various terminologies scattered through the chapters would make them more available.

It is not to be hoped that in a book of this character there should be an absence of errors, although in this instance they are not so numerous as usual. Certainly they do not render the text as a whole unsafe for the unguided beginner. Because of the merit of the book in general and its obvious adaptability to the present needs of a great variety of people, it is particularly important to reduce errors of all sorts to a minimum. Undoubtedly, the cordial invitation of the author for assistance in eliminating these will be met with a helpful response by his fellow workers. Here it should suffice to speak of only more general features needing attention.

Owing to the fact that the book will most largely be used by those generally unfamiliar with cytology, and having varied approaches to it, there is need for the greatest clearness in distinguishing between the different categories of objects and conditions described. This is not always done and there is sometimes confusion between gene and character, and between the valence of the elements in the chromosome complex. In the effort to simplify the presentation of the maturation phenomena in some of the diagrams, only one mitosis is shown. While this displays clearly one of the important conditions of meiosis it entirely neglects another, viz., the essential unity of the two maturation mitoses as a process. This is further emphasized by the consistent use of the terms "heterotypic" and "homotypic." Enough evidence has been presented to show beyond question that the first maturation mitosis is not necessarily a reduction division as the terms imply. It is necessary only to recall the behavior of the sex chromosomes in the Hemiptera and the "selected chromosomes" in Phrynotittix, as described by Wenrich, to demonstrate this. There is something in meiosis besides a reduction division and an ordinary equation division. It is important to show clearly that meiosis is a unique phenomenon.

Doubtless, there are other instances of similar differences in point of view between author and reviewer which might be used to illustrate the present status of opinion in cytology, and the degree of adaptability of the text of Professor Sharp as an introduction to the subject. What has been given will, however, suffice to show that the existing differences of opinion are not extreme, that they are fairly presented in the text, and that in their exposition, a work has been produced that will serve to extend the usefulness and influence of cytology greatly. It is not venturing far to predict that the "Introduction to Cytology" will take its place as a worthy member of the very successful series of which it is a part.

C. E. McCLUNG

SPECIAL ARTICLES

CONTINUOUS RENEWAL OF NUTRIENT SOLUTION FOR PLANTS IN WATER-CULTURES

IN the experimental study of the salt nutrition of plants, it is of course very important that all the influential features of the culture media be definitely known. The initial composition of a mixed salt solution employed for water-cultures may be known with a marked degree of accuracy, but the chemical make-up of such a nutrient solution begins to be altered immediately after the introduction of the plants; materials, of course, move from the roots into the solution, as well as in the opposite direction, and the solution soon becomes significantly different from what it originally was. Since there is no feasible way by which all the various kinds and rates of alteration may be adequately determined, the culture solutions must be renewed from time to time if the growth of the plants is to be correlated with known chemical conditions surrounding their roots, and renewal must be frequent enough to allow these unknown alterations to be regarded as uninfluential.

How frequently water-culture solutions should be renewed is always a difficult question. With small culture vessels, with large plants, or with many plants in a vessel, it is

clear that renewal ought to be more frequent than with larger vessels, smaller plants, and so forth. The labor involved is generally a serious consideration also. Whether solutions were renewed frequently enough, in particular experiments, to allow growth to be correlated with the characteristics of the solutions as these were originally prepared has been a subject of discussion from time to time. To answer this question for any experiment, a number of different renewal frequencies may be simultaneously tested, to determine how often the solutions must be changed in order that no difference in growth may result with still more frequent renewal.

A consideration of this question, together with the amount of labor involved in renewing a large series of solutions, leads obviously to the suggestion that the solution might be made to flow continuously through the culture vessel, the inflow being of known composition and the outflow being discarded. If the rate of flow is rapid enough, the discarded solution will not be significantly different from the inflow, and the roots may be said to have been in a known set of chemical surroundings throughout the culture period. Several rates of flow should be simultaneously tested, at least in a preliminary way, in order to make sure that the data studied shall have been secured with a sufficiently rapid rate. By employing continuous flow, the labor of renewing solutions would be practically avoided, since the apparatus would operate continuously without alteration, aside from the preparation of solutions and their introduction into the apparatus from time to time. The apparatus should automatically maintain any desired rate of flow through the culture vessel.

The need of an apparatus for continuous flow has become increasingly evident throughout the recent development (begun by Schreiner and Skinner, and Tottingham) of water-culture experimentation by means of logically complete series of salt combinations. A preliminary step was taken when Trelease and Free,[1] working in this laboratory in 1916, concluded that Shive's nutrient solution R5C2 (1.75 atm.) gave better growth the more frequently the solution was renewed, a continuous flow giving better growth than did daily renewal. Although, with the gradually improving technique of the water-culture method, many workers[2] have doubtless appreciated the desirability of continuous flow, constantly flowing solutions appear not to have been subjected to any further tests thus far recorded in the literature.[3] It is interesting to note, however, that the logical need of continuously renewed culture solutions was clearly stated by Stiles.[4] when he wrote: "In no case has a constantly renewed culture solution been employed. Thus the ratio of the various constituents was probably constantly changing throughout the experiments, and instead of being a constant factor was an unknown and varying one." Also, Duggar[5] mentioned the need of frequently renewed or continuously flowing solutions, but concluded that any operation involving continuous flow "would be impracticable in most of our experimental work."

This paper is planned to emphasize still further the need of flowing solutions and to present a brief description of an arrangement for securing them.

The accompanying diagram shows the main features of the apparatus, which consists

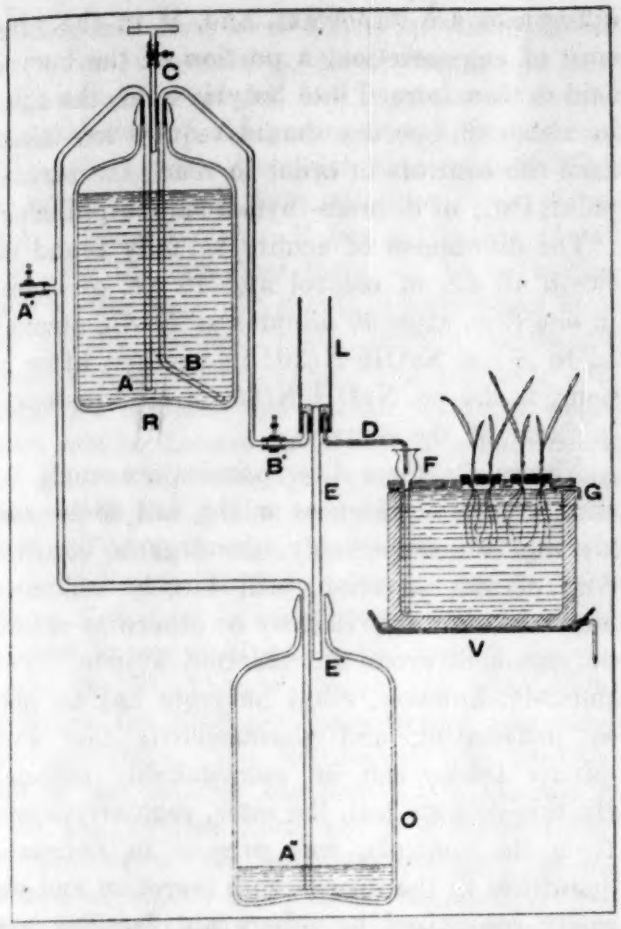
[1] Trelease, S. F., and E. E. Free: "The effect of the renewal of the culture solutions on the growth of young wheat plants in water-cultures. *Johns Hopkins Univ. Circ.*, N. S., No. 3, March, 1917, pp. 227 and 228.

[2] Conner, S. D., and O. H. Sears: "Aluminum salts and acids at varying hydrogen-ion concentrations, in relation to plant growth in water cultures. *Soil Science*, 13: 23-33, 1922, p. 27.

[3] In 1865 Nobbe flowed solution into a vessel in which plants were growing, but he seems not to have tried to control the rate of flow.

[4] Stiles, Walter: "On the interpretation of the results of water culture experiments." *Annal. Bot.*, 30: 427-436, 1916.

[5] Duggar, B. M., "Hydrogen ion concentration and the composition of nutrient solutions in relation to the growth of seed plants. *Annals Missouri Bot. Gard.*, 7: 1-49, 1920, p. 43.—*Idem.*, "The use of 'insoluble' salts in balanced solutions for seed plants." *Ibid.*, 7: 307-327, 1920, p. 308.



essentially of four parts: the upper reservoir (R), the constant-level tank (L), the lower reservoir (O), and the culture vessel (V). The upper reservoir (R) holds 5 gallons of solution when full, and acts like a constant-pressure aspirator, drawing air through tube A'A and delivering solution through the siphon tube (B), to the constant-level tank (L). The latter is a piece of 5-cm. glass tubing closed below by means of a rubber stopper with three tubes, B, E, and D. Solution flows into the tank through tube B, at a rate somewhat greater than is required for the culture vessel, and the excess passes into the lower reservoir (O), through the tube E, the tank level being automatically maintained at the top of the last-mentioned tube. The rate of flow through B is adjusted by adjusting the height of the lower end of tube A with reference to the upper end of E. Solution flows at a practically constant rate from the constant-level tank, through a small-bore delivery tube (D), and drips regularly into the thistle-tube receiver (F) of the culture vessel. The desired rate of flow through tube D is secured by adjusting the height of the upper end of E with reference to the lower end of D—that is, by adjusting the "head" maintained by the constant-level device.

The culture vessel shown is a 3-gallon, glazed earthenware "butter" jar, covered by a paraffined top, of wood, cement or plaster of Paris, with eight large openings, in which are set the flat cork stoppers that support the plants. There are five wheat seedlings in each stopper, forty seedlings in all. The top is supported about 4 mm. above the top of the jar. The receiver tube (F) has a waxed-paper cover, through which passes the delivery tube. Tube F extends nearly to the bottom of the culture vessel, and solution flows into the latter, keeping it filled to the brim and overflowing at the top, through the waste tube (G).

Solution that collects in the lower reservoir (O) has not been vitiated in any way by its passage through the constant-level tank, and it is raised to the upper reservoir (R) from time to time, together with additions of newly prepared solution. This transfer is effected through the tube A"A, by closing cocks A' and B' and applying suction at C (by means of an ordinary filter pump). When the transfer is completed, cock C is closed and cocks A' and B' are opened.

The reservoirs should be covered with opaque paper, to exclude nearly all light and retard the development of algæ.

The constant level device and the lower reservoir may be dispensed with entirely if the temperature of the upper reservoir can be maintained practically constant, or if only an approximately constant rate of delivery of solution is desired. In this case, tube B would discharge directly into the receiver tube (F). This simpler apparatus is the one employed by Trelease and Free.

Doubtless, the apparatus here described may be modified in many ways, to suit the facilities and requirements of different experimenters; but this form operates very satisfactorily. As thus far used, a series of five are delivering five different solutions to their respective culture vessels at a rate of about 16 liters a day, which amounts to 400 c.c. a day for each of the forty plants in the culture. With liter jars, five plants per culture, and solution renewal every three and one half days (as in the plan published by the National Research

Council Committee on Salt Requirements of Plants) each plant would receive 57 c.c. per day.

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March 23, 1922

NOTE ON THE SYNTHESIS OF ETHYL BUTYRATE IN EGG SECRETION

In our analyses of egg secretion, Miss Woodward[1] and I[2] have isolated an enzyme of the lipase group. The material, precipitated as a white powder, is soluble in both sea-water and fresh. In the presence of this "lipolysin," droplets of egg fat decrease in diameter while the hydrolysis of other neutral fats and the cleavage of ethyl butyrate are measurably accelerated.[3]

Since lipolysin is a parthenogenetic agent;[1, 4] since the unmodified egg-secretions also have parthenogenetic[5] and lipolytic[3] powers; and finally, since eggs with secretions removed by brief exposure to charcoal are completely sterile,[3] it seems likely that lipolysis plays some rôle in the normal initiation of development.[1] However, the evidence that egg-secretions have these powers is still incomplete. It has not been reported whether, under conditions significant for fertilization theory, the effects already observed are reversible.

Accordingly, I prepared egg-secretion as free from contamination as possible and used chloroform to inhibit bacterial action. To 10 or 15 c.c. of this, I then added, in one set of experiments, .5 c.c. of absolute ethyl alcohol; in another, 5 c.c. of 2N. Butyric acid was introduced last of all. The final concentration of the acid was roughly .25 N. and .4 N.

The acidity of the systems was, of course, immediately reduced by the salts present in both the secretion and the sea-water. Under the circumstances then, the loss in total acidity has no meaning for the problem in hand. Only differences are important, and, if in the presence of egg-secretion, a portion of the butyric acid is transformed into butyric ester, the tubes in which this occurs should require less alkali than the controls in order to reach the turning point, P_{H_7}, of di-brom-thymol-sulpho-phthalein.

The differences of acidity actually found between 10 c.c. of control and 10 c.c. of digest, in one case, after 40 minutes at 20° C., amounted to .8 c.c. NaOH N/20; in another, after an hour, to 2.4 c.c. NaOH N/20, in both instances, in favor of the controls.

Absolutely, these discrepancies are small, but even greater differences might fail to be convincing, for conceivably, the organic constituents of the secretion, still largely unknown, might in some way destroy or otherwise remove butyric acid from the reaction system. Fortunately, however, ethyl butyrate has an odor so penetrating and characteristic that even minute traces can be unmistakably detected. By this delicate test, the ester, regularly absent from the controls, was present in noticeable quantities in the digests with secretion and was easily recognized by others not familiar with the experiments. For eighteen hours the ester smell continued to grow in intensity.

On the basis of these results, I attribute to egg-exudate the power to accelerate the synthesis of ethyl butyrate. This is neither more nor less than might be expected since the same exudate also accelerates the corresponding hydrolysis.

Otto Glaser
Amherst College,
February 2, 1922

1 Woodward: *J. Exp. Zool.*, Vol 26, pp. 459-501.
2 Glaser: *Am. Nat.*, Vol. LV, pp. 368-373.
3 Glaser: *Biol. Bull.*, Vol. XLI, pp. 63-72.
4 Woodward: *Biol. Bull.*, Vol. XLI, pp. 276-279.
5 Glaser: *Biol. Bull.*, Vol. XXVI, pp. 387-409.

NATIONAL ACADEMY OF SCIENCES

At the annual meeting of the National Academy of Sciences held in the U. S. National Museum, Washington, on April 24, 25 and 26, papers were presented as follows:

The new building of the National Academy and the National Research Council: C. D. Walcott, President of the Academy. The erection of a magnificent building, costing $1,300,000, as the home of the National Academy of Sciences and the National Research Council, will shortly be begun on the square bounded by B and C streets, 21st and 22d streets, northwest, Washington. The

building will serve as a center for American science in its various fields. Here investigators from all parts of the country and from abroad may be brought togther for counsel and cooperation. Facing the Lincoln Memorial, the marble building in simple classical style will rise three stories from a broad terrace. It has a frontage of 260 feet. On the first floor there will be an auditorium seating some 600 people, a lecture hall holding 250, a reading room, library, conference rooms and exhibition halls. The basement concontains a cafeteria and kitchen. The two upper floors will be devoted to offices. The building is the gift of the Carnegie Corporation of New York, while the ground was bought at a cost of about $200,000 through the donations of about a score of benefactors. Bertram Grosvenor Goodhue of New York is the architect. He is one of the best known architects in the country and designed the St. Thomas Church, the West Point buildings, the Nebraska State Capitol and many other buildings. The contract for the construction of the building has been let to Charles T. Wills, Inc., of New York, and it is expected that the building will be ready for occupancy in the autumn of 1923. Lee Laurie, the sculptor, has been selected to do the decorations, which will symbolize and depict the progress of science and its benefits to humanity. A series of bronze basreliefs will show a procession of the leaders of scientific thought from the earliest Greek philosophers to modern Americans. On passing through the entrance hall the visitor will find himself in a lofty rotunda. Here he will see in actual operation apparatus demonstrating certain fundamental scientific facts that hitherto he has had to take on hearsay. A coelostat telescope, mounted on the dome of the central rotunda, will form a large image of the sun on the white surface of a circular table in the middle of the room. Here visitors will be able to see the sun-spots, changing in number and form from day to day, and moving across the disk as the sun turns on its axis. A 60 foot pendulum, suspended from the center of the dome, will be set swinging through a long arc, repeating the celebrated experiment of Foucault. The swinging pendulum will mark an invariable direction in space, and as the earth and the building rotate beneath it, their rotation will be plainly shown by the steady change in direction of the pendulum's swing over a divided arc. Two great phenomena of nature, the sun and the rotation of the earth, are thus to be exhibited. Other phenomena to be demonstrated in striking form in the central rotunda are magnetic storms, earthquakes, gravitational pull of small masses, the pressure of light, the visible growth of plants, swimming infusoria in a drop of ditch water, living bacteria and other interesting phenomena. In the seven exhibition rooms surrounding the central rotunda the latest results of scientific and industrial research will be illustrated. One room will be set aside for the use of government bureaus, another for industrial research laboratories, others for the laboratories, observatories and research institutes of universities and other institutions. The newest discoveries and advances in the mathematical, physical and biological sciences and their applications will be shown in this living museum, whose exhibits will be constantly changing with the progress of science. One week there may be displayed the latest forms of radio telephony; the next perhaps a set of psychological tests or a new find of fossils or a series of synthetic chemical compounds. Such a mutating museum will continue to attract and instruct large numbers of tourists and residents.

Queries concerning the origin of the Australian floras: PROFESSOR D. H. CAMPBELL, Leland Stanford, Jr., University, California. (1) The conditions in the north and south temperate zones are very different. The boreal floras are relatively uniform, owing to the proximity of the Eurasian and North American continents. The south temperate floras are much less intimately related on account of the extreme isolation of the principal land masses, viz., South America, South Africa and Australia. (2) An early separation of the land masses of the northern and southern hemispheres is indicated by the very great differences between the vegetation of the north and south temperate zones. The most prominent types in each region are either completely absent from the other, or very sparingly represented. The south temperate zone has no oaks, chestnuts, walnuts, poplars, maples and many other deciduous trees and shrubs of the north. On the other hand, the Casuarinas and Proteaceæ (Banksia, Grevillea, etc.), the Eucalypti and other Myrtaceæ, as well as many other evergreen trees and shrubs, are unknown in the northern regions. The same is true of the Conifers. The true pines, firs and spruces of the north are replaced by the Araucarias, Agathis and Podocarpus of the south. (3) Australia presents an extraordinary degree of endemism, especially in western Australia, the headquarters of the autochthonous flora. (4) Australia has three distinct floras—*a.* The tropical rain-forest of the coastal regions of Queensland and New South Wales.

b. The sub-antarctic flora of Tasmania and the alpine regions of New South Wales and Victoria. *c*. The autochthonous flora, practically universally distributed, but especially developed in western Australia. (5) The tropical vegetation of northeastern Australia is evidently closely related to the floras of New Guinea and the Malay Archipelago. (6) The sub-antarctic flora, especially developed in Tasmania and New Zealand, is evidently related to the Fuegian flora of South America. It has been the subject of repeated investigation. (7) The autochthonous flora, which comprises a large majority of the Australian plants, is the main subject of the present discussion. This flora is supposed to have developed in western Australia, when it was completely separated from the eastern part of the continent, and to have later spread over the whole continent. The main problem at hand is to discover evidence which will throw light on the origin of this flora. (8) There are some notable correspondences between the flora of South Africa and Australia indicating some former land connection; but as yet no evidence for this has been found, except at a very early period. (9) Gondwana Land, the great southern continent, believed to have existed at the end of the Paleozoic, is supposed to have united South America, Africa and Australia; but a much later connection between South Africa and Australia must be assumed to explain the resemblances between their present floras, as presumably there were no Angiosperms in existence at the period of the supposed Gondwana continent. What is particularly needed is evidence showing the relation of the land masses of the southern hemisphere during the Cretaceous and the Tertiary. Especially important is a knowledge of the fossil plants of these periods, from temperate South America, South Africa and Australia. (10) It is possible that when the fossil plants from these regions are thoroughly studied it may prove that in the south temperate zone, as in the corresponding northern latitudes, during the Cretaceous and much of the Tertiary a practically uniform flora prevailed. Should such prove to be the case, it is probable that the existing floras in the south temperate regions are the descendants of this uniform flora, which shut off in these completely isolated areas have become altered to a greater or less extent. Western Australia, the most completely isolated of the southern regions, has developed the richest and most specialized flora.

The nature of disease, resistance or immunity in certain plants: PROFESSOR L. R. JONES, J. G. DICKSON and J. C. WALKER, University of Wisconsin.

A side effect from the importation of parasites of injurious insects: DR. L. O. HOWARD, chief of the Bureau of Entomology, Department of Agriculture. In the efforts to bring about a natural biological control of injurious insects in many parts of the world, an increasing amount of work is being done by the entomologists of the different nations to bring into their own countries the foreign parasites of foreign insect pests that have been accidentally introduced and have become established. In the course of this work, the motivating idea is the control of the specific introduced pest; but it has developed in many instances that the introduced parasite is not specific to the introduced host, but attacks allied native injurious species. The speaker described a number of these instances in America. These findings offer a very strong additional argument in favor of the prosecution of work of this character.

Mitochondrial bodies in the spermatogenesis of Chorthippus Curtipennis (Scudd.): DR. E. L. MARK and L. C. WYMAN, Harvard University. Numerous bodies found in the apical (Verson's) cell of the testicular follicle, as well as in the primary and secondary spermatogonia, the first and second spermatocytes, and the spermatides of this grasshopper are described as spheroidal structures composed of two substances, a central nonstainable core and a deeply stainable mantle or cortex. The appearance of the bodies when stained is that of a vesicle with clear contents and stained wall of no great thickness. They occur in a single large cluster, or in smaller groups, and are accompanied by finely granular deeply staining cytoplasmic substance. These vesicle-like bodies are believed to be mitochondria, and are genetically continuous from the primary spermatogonium to the formation of the spermatid. In the metamorphosis of the spermatid into a spermatozoon their history has been traced till they break up into minute granulations enveloping the axial filament of the thread-like mature spermatozoon. At each of the cell divisions of spermatogenesis the vesicles are collected into a ring at the periphery of the equatorial region of the spindle figure, and soon after the chromosomes divide and separate, in the metaphase of cell division to form two daughter nuclei, it is found that these vesicles are likewise arranged in the form of two parallel rings—each containing about the same number of vesicles—one on each side of the

plane of cell division, and that with the constriction of the cytoplasm during the division each ring occupies a position between the nucleus of the daughter cell and the cell plate. This ring becomes condensed into an irregular disk which lies close to the nuclear membrane, where it remains during the interkinetic, or so-called resting, stage. On the approach of cell division, the disk breaks up into clusters of vesicles, varying in number from two or three to a dozen or more, which become distributed irregularly through the cytoplasm, but chiefly in regions peripheral to the spindle figure. During the late prophase and early metaphase of nuclear division, the clusters of vesicles with their enveloping finely granular matter are again collected into an equatorial ring. At the end of the second maturation division, which results in the formation of the spermatid, the vesicles, at first small and numerous, constitute a thick disk-like structure at one pole of the nucleus. By the time the chromatin has resumed the appearance of a fine network, two things have happened in the disk-like group of vesicles, now become spheroidal; by confluence they have increased in size and diminished in number; at the same time a differentiation has taken place in them so that a few small centrally-located ones, probably not resulting from confluence, are deeply stainable, whereas the more peripheral and larger ones have become so distended with nonstainable substance that they appear very pale. The confluence of the peripheral pale vesicles continues till there are only two, which are mutually flattened in a plane passing through the center of the nucleus. Each of the two contains a small number of the small deeply staining vesicles. Meanwhile the cytoplasm on the side of the cell corresponding to the vesicles begins to elongate to form the tail. Then the two vesicles move away from the nucleus a short distance and eaeh becomes spheroidal. Between the two appears the axial filament and as the cytoplasmic outgrowth becomes still more elongated, the two spheroidal structures also become elongated in a direction parallel with the axial filament, which they closely invest. The small contained deeply staining vesicles become arranged in a longitudinal row; the wall of the outer enveloping sac disappears, setting free the deeply staining vesicles, which now become distributed along the axial filament, and finally break down, furnishing the finely granular envelope enclosing the axial filament.

Vegetative types of Datura due to differences in somatic number of chromosomes: DR. A. F. BLAKESLEE, Carnegie Institution of Washington, Cold Spring Harbor, L. I., N. Y. Normal plants have 2 n chromosomes in somatic cells. Certain Datura mutants differ in chromosome number from the norm. Of *balanced* types, with an equal number of chromosomes in each set, forms occur with 1 n, 3 n and 4 n chromosomes. Of *unbalanced* types, with an excess or a deficiency of one or more chromosomes in one or more of the individual sets, forms occur with such somatic formulæ as (2n + 1) and (4n — 1). These differences in chromosome number, especially in unbalanced types, cause distinct differences in somatic structure. Several thousand vegetative forms are considered theoretically possible from chromosomal types already discovered.

A method for the study of filterable viruses as applied to vaccinia: DR. W. G. MACCALLUM and E. H. OPPENHEIMER, of the Johns Hopkins University. Attempts at the isolation of the infective agent in vaccine and smallpox have failed. It can at least be separated from most contaminating material if it be centrifugalized in a suspending fluid of appropriate specific gravity. The infective material in vaccine lymphs rises to the top in a fluid of specific gravity 1.16 and sinks to the bottom in any fluid of specific gravity lower than 1.13.

Continuation report on experiments in epidemiology: DRS. SIMON FLEXNER and H. L. AMOSS, Rockefeller Institute for Medical Research. The continuation report on epidemiology relates first to the epidemic disease, mouse typhoid, reported on at the last spring meeting of the academy, and second to an epidemic disease, rabbit septicemia, which is not infrequently met with among domesticated rabbits and the nature of the spread of which we have undertaken to study under controlled experimental conditions. These two diseases represent also two divergent modes of propagation of epidemics of disease, namely, by way of the gastrointestinal organs as in mouse typhoid, and through the respiratory organs as in rabbit septicemia. The ultimate purpose of the investigation is the securing of precise knowledge which may come to bear on and extend knowledge regarding the manner of spread and its underlying causes of such epidemic diseases in man as meningitis, poliomyelitis, influenza, cholera, etc.

Replantation of entire limbs without suture of vessels: DR. W. S. HALSTED, Johns Hopkins Hospital, Baltimore, Md. The experiments were made in the effort to ascertain the cause of the swelling of the arm after the radical operation for cancer of the breast. This swelling has been

universally attributed to the excision of the lymphatics or lymphatics and veins of the axilla. The author believes that infection is the essential factor. In our experiments a cut was made through all of the tissues of the thigh except the sciatic nerve, femoral artery, femoral vein, and femur. The divided structures were immediately sutured and the wound completely closed. At various periods after the operation the vein and artery were ligated. In one instance two days sufficed, but ordinarily four days were required for the adequate reestablishment of the venous circulation through the scar. The artery can not be safely tied until about the twelfth (?) day. The grafted limb becomes swollen for only a few days after the amputation, and again in some instances for a day or two after ligation of the vein. Lantern slides were shown of the new vessels passing through the scar which alone maintain the life of the leg. An operation for cancer of the breast which eliminates the danger of a swollen arm was briefly described and illustrated.

Recent discoveries on the antiquity of man: Dr. H. F. Osborn and C. A. Reed.

Stature and head form in Americans of old families: Dr. A. Hrdlička. Conditions to be reported upon are a part of the results of a careful study of a large group of adult normal men and women descending from families three to eight generations born American. The stature averages 5 feet 8½ inches in the men and nearly 5 feet 4 inches in the women, which is well above the general mean of this country and is higher than in any large group of whites in Europe. The head is of good size, particularly so in the women. The form of the head, however, shows a great variation, indicating only little tendency so far towards any intermediate, American, type. The type of physiognomy shows a closer approach towards such a type, though similar changes are also observable in the better classes of England.

Animal evolution: Dr. Austin H. Clark, U. S. National Museum.

The distribution of the Motmots of the genus Momotus: Dr. Frank M. Chapman, American Museum of Natural History. The Motmots, a distinctively American family of birds, range from the northern limit of the tropical zone in northeastern Mexico to its southern limit in northern Argentina. The family contains six genera and approximately fifteen species and twenty-one sub-species, of which about one half are included in the genus *Momotus*. Motmots are believed to have originated in Middle America whence they have made at least three invasions into South America, one probably pre-Andean and two post-Andean. The first invasion reached the forested area of southeastern Brazil where the now existing species is separated from its nearest ally by an area 1,000 miles in width in which no member of its genus (*Baryphthengus*) is known. This hiatus in the range of the group was possibly occasioned by the entrance of the sea into the Amazon Valley. The second invasion carried a form into the Andean subtropical zone from Costa Rica, over a Panama subtropical "bridge" which has since subsided, almost to Bolivia. The third invasion, made apparently from Panama, populated northern Colombia, the coastal region of Venezuela, Trinidad and Tobago, which were doubtless at that time attached to the continent. Subsequently the birds doubtless crossed the Andes over the comparatively low Andalucia Pass at the head of the Magdalena Valley, and spread over the greater part of tropical South America. In this area they have become differentiated into nine recognized races which present interesting responses to their environment, including some marked instances of convergence. The extreme forms, occupying different banks of the lower Amazon, have apparently become specifically distinct although they evidently have a common ancestor with which they are still connected.

New results on the theory of the minor planets: Professor A. O. Leuschner, University of California (by title).

Dark nebulæ: Professor H. N. Russell, Princeton University (by title).

The larger results of twenty years of solar radiation observations: Dr. C. G. Abbot, Smithsonian Institution, F. E. Fowle and L. B. Aldrich. This report gave a summary of twenty years' study of solar radiation. This is one of the most important of the constants of nature, for upon it depends the energy required for all our machinery and our muscular power. If the sun varied as much as the other stars, we should alternately freeze and fry. But Dr. Abbott's examination of all available evidence shows that the sun's heat has not varied more than six per cent. above or below the average in the last twenty years. But whenever a series of spots pass across the surface of the sun the amount of heat and light given off falls from one to five per cent. Any such change in the sun's rays has an effect upon the weather and electrical conditions of the earth. It is therefore

possible to tell what the weather is going to be by watching the sun. The Weather Bureau of Argentina sent out forecasts a week in advance based upon the solar observations telegraphed in daily from the Smithsonian Institution at Montezuma, Chile. From compilation of about 2,000 observations, it has been found that the heat radiated by the sun amounts to 1.94 calories per square centimeter per minute. This would be sufficient to melt a layer of ice 424 feet thick all around the sun. A large number of by-products relating to the temperature of the sun, transparency of the atmosphere, the number of molecules per cubic centimeter in the atmosphere, the brightness of the sky, the cooling of the earth by long-wave rays, the distribution of brightness over the sun's disk, and the general theory of the nature of the sun have come out of the investigations.

Problems of modern physics: DR. H. A. LORENTZ, University of Leyden. The lecture passed in review some problems of prominent interest. Foremost among them are the quantum theory, the problems of atomic structure and of gravitation. All these are awaiting their solution and much remains also to be done before it will be possible to explain the properties of magnetic substances, to account for terrestrial and solar magnetism and to understand the more complicated forms of the Zeeman effect. The motion of electricity in metals and effects connected with it likewise require laborious investigation. Here much may be expected of low temperature research.

Researches on thiazoles: DR. MARSTON TAYLOR BOGERT, Columbia University. In the benzothiazole group, various new derivatives have been prepared and studied, several of which are interesting because of therapeutic or tinctorial possibilities.

Researches on selenium organic compounds: DR. MARSTON TAYLOR BOGERT. New selenium organic compounds have been synthesized and studied in the quinazolone and benzelenasole groups, the azo dyes from the latter being much deeper in shade than the corresponding sulfur compounds.

Reaction between silver perchlorate and the halogens: PROFESSOR M. GOMBERG, University of Michigan. A study of the reaction indicated in the title has been undertaken in order to prepare, if possible, the compound radical (ClO_4):

$$2AgClO_4 + I_2 = 2AgI + 2(ClO_4).$$

If found to exist as monomolecular it should, it was thought, be either identical or isomeric with the ion of the same composition; if dimolecular, $(ClO_4)_2$, it should prove a higher oxide of chlorine than any hitherto known. Numerous experiments were carried out during the last year, with the halogens chlorine, bromine and iodine, and with solvents chosen from a wide range of compounds. Iodine and ether were finally adopted as best suited for this reaction, because of the formation of less by-products. At this stage of the investigation it may be considered as having been fairly well established that $(ClO_4)_x$ actually does exist, but its molecular state has not yet been determined. The compound has been prepared only in solutions of one per cent. to five per cent., and has been found to be practically non-volatile with vapors of ether at 30° C. and 100 mm. pressure. It is a powerfully reactive substance. It reacts with the oxides of various metals; it attacks zinc, magnesium, copper, silver, iron, tin, and other metals with the formation of the corresponding perchlorates; with water it gives perchloric acid, and it liberates iodine from hydriodic acid. The investigation is to be continued.

The thermal decomposition of tungsten: DR. GERALD L. WENDT.

A confirmation of Saha's theory of the ionization of the elements at high temperature: DRS. ARTHUR A. NOYES and H. A. WILSON, California Institute of Technology. By employing the usual thermodynamic expression for the change of chemical equilibrium with the temperature, and supplementing this by an evaluation, based on fairly well established theoretical considerations, of the specific constants occurring in that expression, Saha (*Phil. Mag.*, 40: 479, 1920) has shown that one can compute from the ionization-potential of an element the extent to which its neutral atoms are converted into ions at any temperature or pressure; for example, the extent to which sodium undergoes the reaction $Na = Na^+ + e$, where e denotes the electron. This computation has proved of great astronomical interest because of the new possibilities it affords of interpreting the presence, absence, or relative intensities of the spectra of certain elements under different stellar conditions. The fact, however, that Saha's computations involve certain hypotheses makes the experimental confirmation of his conclusions highly desirable; and it is the purpose of the authors' paper to show that the experiments of one of them (H. A. Wilson) on the electrical conductivity of flames furnish such a confirmation.

The general system of isotopes as related to the formation and disintegration of atom nuclei:

PROFESSOR WILLIAM D. HARKINS, University of Chicago. The nucleus of any complex atom may be considered as a highly condensed proton-electron aggregate. Up to the present none of these condensed aggregates have been found to be electrically neutral (neutrons), and in *most* atoms which exist on earth and in the meteorites each electron binds two protons. Thus the composition of the nuclei of most atoms may be expressed by the formula $(p_2e)_M$, in which p represents a positive electron (proton), e an electron, and M is the atomic number. No atomic species has been discovered in which one electron binds more than two protons. The simplest complex nucleus is that of the helium atom (the alpha particle) which has the formula $(p_2e)_2$ This is also the most abundant group present in more complex nuclei. It was shown by Harkins and Wilson in 1915 that according to the special relativity theory the amount of energy liberated in the formation of four grams of helium from protons and electrons, that is, from hydrogen, is 6.7×10^{11} calories, or five million times the energy liberated when the same weight of hydrogen unites with oxygen to form water. This is about three fifths of the energy which would be liberated in the complete change of 238 grams of uranium into 206 grams of lead, 32 grams of alpha particles, —6N electrons (where N represents the avogadro number) and about 0.05 grams of radiant energy. The energy which would be liberated in the formation of alpha particles from hydrogen is so great that it would seem that this reaction should proceed at an extremely high speed. That this is not the case may be due to the fact that for some unknown reason one electron does not form a very stable union with one proton, but the common ratio is two of the latter to one of the former in the most stable aggregates. Thus it is not improbable that four protons and two electrons seldom meet at one time in such relative positions as to allow the alpha particle to be formed. It may be suggested that the first step in the building of an alpha particle may be the formation of the aggregate p_2e, which is stable with reference to aggregation, but easily unites with a like particle to form the group $(p_2e)_2$, or the alpha particle. According to Rutherford's hypothesis the carbon nucleus consists of four groups of the formula p_3e. While the evidence in favor of this assumption is not specially convincing, there is on the other hand no evidence against it. However, definite evidence will be presented which proves that the alpha particle is the principal group concerned in the growth of carbon nuclei into those which are heavier. The composition of any complex nucleus may be expressed by the formula $(p_2e)_M(pe)_n$, in which n represents the *isotopic number*. This number varies from 0 to 54 for known atomic species, and is 0 for most atoms. In the range in which the isotopic number is small, the most abundant species of atoms are those whose isotopic numbers are divisible by 4, while for higher isotopic numbers the maxima of abundance are not so distinct, and occur in general for the isotopic numbers which are even. The most important relations which should be taken into consideration in showing the nature of the general system of isotopes are: (1) The number of negative electrons in most atom nuclei is *even*, so in general the atomic weight and the isotopic number are both even when the atomic number is even, and are both odd when the atomic number is odd. (2) As the atomic number increases the isotopic number of the more stable isotopes of an element also increases. This may be expressed as follows: As the *net* positive charge on an atom nucleus increases the atom becomes more unstable unless at the same time the nucleus becomes more negative with reference to its *relative* content of negative electrons. (3) For any set of isotopes the atoms become more unstable with reference to a beta disintegration as the isotopic number increases, and more unstable with reference to an alpha particle disintegration as the isotopic number decreases. This relation does not specify what form of disintegration will take place in any special case, since this probably depends upon the grouping, but it does give the relative rate for any disintegration which actually does take place. Obviously this relation has been tested only in the case of the radioactive elements. The relations which exist in the general system of isotopes will be presented in the form of an extensive plot which exhibits a large number of relations, many of them periodic, which can not be well treated in an abstract.

A theory of electric conduction in metals: PROFESSOR EDWIN H. HALL.

Cooperative studies of California earth movements: DR. ARTHUR L. DAY, director of the Geophysical Laboratory, Carnegie Institution of Washington. Recent information from astronomical sources has indicated a northward crustal movement of small magnitude in northern California. The suggestion has been made that the accumulated strains produced by such movement eventually produce rupture and an elastic recoil

or earthquake. Cooperative studies have been undertaken by the Carnegie Institution of Washington, U. S. Coast and Geodetic Survey, U. S. Geological Survey, the geological departments of the universities of California, the California Institute of Technology, and the Bureau of Standards, with the purpose of gathering precise data bearing upon this subject. It is a part of the program not only to locate the surface displacements either gradual or disruptive, but also to develop instruments and establish stations for the location of sub-surface zones of movement.

Geological overthrusts and underdrags: PROFESSOR W. M. DAVIS, Harvard University (by title). Overthrust masses of earth crust have been found, the front of which has advanced a score of miles or more beyond its original position. On tracing such masses backward, no indications of a cavity left by their advance have been found; hence it may be possible that they have obliquely emerged from beneath rear portions of the crust which have not taken part in their movement. If so, the rear portions should exhibit displacements due to what may be called the "underdrag" of the obliquely emerging masses. Such displacements would be characterized by an increase in horizontal dimensions in the direction of underdrag, and manifested by normal faults on moderately slanting fault planes. The mountain ranges of the Great Basin of Utah and Nevada appear to exhibit such displacements.

The effects of winds and barometric pressures on the Great Lakes: DR. J. F. HAYFORD, Northwestern University. The surface of the water of any one of the Great Lakes is never level except by accident. It always has a slope in some direction, produced by the wind, by barometric pressures, or by the water of the lake oscillating as if it were in a great wash-basin. The correct knowledge of these things is a key to various scientific problems and ultimately will prove to be worth millions, in their application, to the people of the United States. It has long been known that a wind blowing over a lake tends to pile up the water on the lee shore and to pull it down on the windward shore. How large is this effect? Is the response of the water to the wind immediate? It has not been possible to answer these questions confidently in the past. Now it is known that the response is prompt and that the effect of a given wind in disturbing the water level at any point in the world may be computed in advance. It is known that the strongest winds that blow have almost no effect in changing the water level at various points, as, for example, at Milwaukee on Lake Michigan and Mackinaw City on Lake Huron. On the other hand, it is known that a wind of 50 miles per hour from the southwest piles up the water a foot at Buffalo and pulls it down simultaneously more than a foot at the west end of Lake Erie. The reason for this extreme contrast between different places and for the fact that the wind effect is greatest in long shallow bays is now accurately known. The lake surface is also continually tilting up, first in one direction, then in another, in response to varying barometric pressures. The water tends to go toward a region of low barometric pressure and pile up there. Such effects at Mackinaw City and Milwaukee frequently amount to three inches or more, although wind effects at these points are almost inappreciable. Just as a piano string struck once, or the air in an organ pipe continuously agitated by a reed, vibrates with its natural period, so the water of each of the Great Lakes under the many impulses given it by the winds and barometric pressures oscillates back and forth. Sometimes the whole of a lake is concerned in an oscillation, and sometimes the lake oscillates in parts. Such oscillations in lakes are called seiches.

Striking similarities between the igneous rocks of Brazil and South Africa: DR. H. A. BROUWER. Striking similarities in geological age and in composition exist between the old granites and gneisses with intrusive younger granites, the pre-cretaceous intrusive sheets of diabase, the lava flows of the Serra Geral and the Drakensberg, the pipes and dykes of kimberlite and the intrusive and effusive alkali rocks (nephelinesyenites, phonolites, etc.). The alkali rocks are found on both sides of the Atlantic Ocean near the coast; they form denuded volcanic centers and if the west coast of Africa and the east coast of South America be considered in juxtaposition the location of these older volcanoes would be very similar to that of the young volcanoes of alkali rocks (Kenia, etc.) near the young fracture-system, bordering the rift valleys in East Africa. Very long dykes of nephelinesyenites prove the existence of similar fractures in the central part of South Africa.

Fauna of the Pleistocene asphalt deposits of McKittrick, California: DR. JOHN C. MERRIAM, president of the Carnegie Institution of Washington, and CHESTER STOCK, University of California. The discovery of an enormous accumulation of perfectly preserved remains of extinct animals found in asphalt beds in the environs of Los

Angeles, California, some years ago furnished some of the most interesting data on the history of life thus far secured in America. A similar deposit representing an assemblage of animals of a somewhat different type has recently been opened for extensive investigation on the western border of the Great Valley of California. Remains of a wide variety of higher animals and birds were found at this new locality. The collection represents the geological period immediately preceding the present and offers the best opportunity thus far known to study the life of this late geological stage under the conditions obtaining in the Great Valley of California.

The telephone engineer a public trustee: FRANK B. JEWETT, vice-president, Western Electric Company. In his paper, which was a statement of the unique position which the telephone engineer of to-day occupies in relation to the general public, Dr. Jewett outlined the organization of the communication service of the United States and pointed out the position and scope of work of the engineer in this organization. Dr. Jewett indicated that the telephone art, even at the end of nearly half a century of the most intensive development and monumental growth, was still far from being an agency requiring little or no change. He showed that the recent developments in physical science had opened up vast possibilities of new and improved communication services which the telephone engineer was endeavoring to make available for public service, and indicated some of the problems which were being successfully attacked. He also pictured some of the tremendous difficulties which confronted the telephone engineer in incorporating these new services into the existing structure, which was itself growing rapidly along already developed lines, without producing disruptions of service. Finally he pointed out that the telephone engineer of to-day had come to recognize that his function was in effect that of a public trustee and that his problem was not alone that of developing new and improved instrumentalities, but of developing these instrumentalities and making them available to the public without subjecting the telephone user to annoyance as a result of experimentation on the public at large.

The loud speaking telephone: FRANK B. JEWETT, vice-president, Western Electric Company. For many years, and in fact almost from Dr. Bell's discovery that human speech could be transmitted to distant points electrically, there has been incessant quest for a satisfactory loud speaking telephone. Innumerable attempts to devise instruments of this kind have been made in the last thirty or forty years and until recently all have been substantial failures. Recently, however, really successful instrumentalities have been produced and the field of possible influence on all social and human relations which has opened up was evidenced graphically in the Armstice Day exercises attendant upon the burial of the Unknown Soldier at Arlington, Virginia. In these ceremonies vast audiences in San Francisco, New York and Washington listened to the President of the United States and other speakers and joined in common exercises of respect to America's dead. Dr. Jewett's paper, which was illustrated by a local demonstration and by a demonstration of talking over the regular telephone wires from New York, described the physical and electrical problems whose solution had to be achieved in order to make the loud speaking telephone a success. He pointed out that the problem consisted essentially of four main elements, namely: (1) The development of telephone transmitters capable of picking up the sound vibrations of the speaker's voice when the latter was speaking normally at some distance from the instrument, and of faithfully translating these vibrations into electrical vibrations for transmission over the wires; (2) the transmission of these electrical vibrations undistorted to the distant point; (3) the amplification at the distant point of the received electrical impulses to an energy value many times greater than that produced by the transmitter at the speaker's end of the line; and (4) the translation back into sound vibrations of these greatly amplified speech waves through an appropriate loud speaking receiver. He pointed out that if the received speech through the loud speaking receivers was to be of acceptable quality no serious distortion could take place in any of the links of the chain from the speaker to his distant audience, and that the inherent characteristics of the loud-speaking system call for even more faithful reproduction than is necessary in ordinary telephones of recognized good quality. He pointed out further that because of the necessity of using ordinary telephone lines, which in most cases were in close proximity to numerous other telephone lines used in the regular way, it was necessary that the currents transmitted from one end of the line to the other should be substantially of the same magnitude as those produced in the use of the ordinary telephone. He showed that this requirement, combined with the necessarily inefficient energy characteristics of the originating transmitter and the tremendous energy

requirements of the loud speaking telephones had made the problem inherently insoluble until means had been developed for producing telephone lines with very uniform transmitting characteristics and until amplifying devices of great power, uniformity and freedom from inherent distortion production had been developed.

The physical examination of hearing and binaural aids for the deaf: R. L. WEGEL, Western Electric Company, New York City. The function of the auditory sense is to detect sounds of different wave shapes, the ratio of the pressure on the ear drum varying over a range of 1 : 1,000,000. It must also differentiate between sounds so nearly alike that no existing physical apparatus is capable of separating them. Binaural audition adds a sense of orientation and discrimination together with a more uniform sensitivity for sounds approaching from different directions. A binaural set for aiding the hard-of-hearing was exhibited. An abnormal auditory sense may be regarded as one lacking to a greater or less degree in (1) range of sensation (frequency or intensity), (2) quality of sensation in various regions of the range, (3) binaural sense. Methods have been studied for exploring the outstanding elements of these functions. A new audiometer for measurement of hearing was shown.

The relative sensitivity of the ear at different levels of loudness: DR. DONALD MACKENZIE, Western Electric Company. Up to the present time there has been no satisfactory technique for loudness comparisons of different tones. In this paper a description is given of an alternation phonometer which makes it an easy matter to adjust to equal loudness two tones of different pitches. With this instrument a determination has been made of the relative sensitivity of normal ears of both men and women, over the pitch range from bass G to C5, at sound intensities midway between the faintest audible and the painfully loud. It is found that the sound energy necessary to produce a given loudness is smaller the higher the pitch, at least within the range examined. Different ears agree more closely at these intensities than at the least audible, and no difference is detectible between men and women. Interpretation of the results shows them to be in harmony with Fechner's law, according to which the difference between the sensations due to two lights of the same color or two tones of the same pitch is proportional to the ratio of intensities of the lights or sounds causing the sensations. This simple law holds only at moderate intensities. Phonometric comparisons by a small number of observers were made at intensities from very faint to very loud. It appears that any one ear varies from day to day, but these variations are most noticeable at the extremes of loudness. The results taken all together strongly suggest that, on the average, the relative sensitivity of the ear to different musical notes is practically the same whether the sounds are loud or faint.

Recent progress in aeronautics: PROFESSOR J. S. AMES, The Johns Hopkins University.

Coefficients of slip and the reflection of molecules: DR. R. A. MILLIKAN, Norman Bridge Laboratory of Physics, Pasadena. This paper contains a presentation of the theoretical relations between the coefficient of slip and the law of reflection of gas molecules from the surfaces of solids and liquids. It presents, also new experimental data taken by the author and his pupils which completely check the correctness of this theory. It gives for the first time the exact ratio between the number of impinging molecules which are specularly reflected in the case of a given gas from given liquid and solid surfaces, and the number which are diffusely reflected. The most interesting facts brought to light by the investigation are, first, that this ratio is different for different kinds of molecules when the nature of the surface remains constant, and, second, that there is a larger coefficient of slip between oiled surfaces and gases than between the same gases and ordinary unoiled surfaces of metal or glass.

Origin of penetrating radiations of the upper air: DR. R. A. MILLIKAN, Norman Bridge Laboratory of Physics, Pasadena. It is of intense interest to know whether the penetrating radiations which have been heretofore studied up to altitudes of 9,000 meters are of cosmic or of terrestrial origin. Pre-war observations made in manned balloons in Germany gave indications that they were of cosmic origin. Observations published last year from the University of California were in opposition to this view. Indeed, the California observers attributed the increase in the rate of discharge of the electroscopes with increasing height, as found in Germany, to the effects of temperature upon the electrical conductivity of the supports of the gold leaves in the electroscopes. The observers at the California Institute of Technology have definitely proved that the temperature effects upon the supports when the experiments are properly performed are practically negligible. They are now making balloon flights in which self-recording instruments are sent up to the very top of the atmosphere, that is, to a point at which only one sixteenth of the atmosphere is

still above, and should be able to determine with certainty by these experiments whether the penetrating rays are of cosmic or of terrestrial origin. While the instruments sent up weigh but 175 grams (6 ounces) they are capable of bringing back a complete record of the temperatures, the pressure, and the penetrating radiations existing at all of the altitudes which they reach. These altitudes should be about three times as great as those ever obtained before in experiments of this kind. These balloon flights will be reported later.

On the measurement of a physical quantity whose magnitude is influenced at random by primary causes beyond the control of the observer, and on the method of determining the relation between two such quantities: DR. WALTER A. SHEWHART, New York City. The objects of scientific investigation are twofold, *i. e.*, the determination of some form of average value and its probable variation, and the determination of the relation existing between two or more such quantities. In many problems of physical and engineering science it is possible to assume that causes of variation of the variable under consideration may be controlled by the observer. Certain problems in these sciences as in the fields of economics and biology arise, however, wherein it is impossible to control the causes of variation, and they must be submitted to a statistical method of solution. An outline of the necessary analysis is given and illustrated. Application of the theory of correlation and its physical interpretation was discussed.

Ether-drift experiments at Mount Wilson in 1921 and at Cleveland in 1922: PROFESSOR DAYTON C. MILLER, Case School of Applied Sciences, Cleveland, Ohio. The Michelson-Morley experiment to detect the relative motion of the earth and ether was performed at Cleveland in 1887. In explanation of the null result then obtained, the Lorentz-FitzGerald effect was proposed. The experiment was repeated by Morley and Miller in 1904, with a much larger and more sensitive apparatus, which was also especially arranged to make a direct test of the Lorentz-FitzGerald effect. Again a null result was obtained. The suggestion was then made that the earth drags the ether, and while there is no "drift" at the surface of the earth, it might be perceptible at an elevation above the general surface. The experiment was again performed by the present author, at the Mount Wilson Solar Observatory in March and April, 1921, where the elevation is nearly 6,000 feet. The results indicated an effect such as would be produced by a true ether-drift, of about one tenth of the expected amount, but there was also present a periodic effect of half the frequency which could not be explained. The interferometer had been mounted on a steel base and in order to eliminate the possibility of magnetic disturbance, a new apparatus with a concrete base and with aluminum supports for the mirrors was constructed. Observations were made in November and December, 1921, the results being substantially the same as in April. Before any conclusions can be drawn, it is necessary to determine the cause of the unexplained disturbance. The interferometer has again been mounted at Case School of Applied Science, in Cleveland, and observations are now in progress, the results of which were reported in this paper, which was illustrated by lantern slides and motion-pictures. About 700 feet of motion-picture film was taken at Mount Wilson by a member of the observatory staff, showing the location and construction of the apparatus and also the method of making the observations.

Some extensions in the mathematics of hydromechanics: DR. R. S. WOODWARD, Washington, D. C. The most general specification of fluid motion requires a minimum of twenty symbols, or factors. Of these the most important are the three velocity components, the three spin components, and the four potentials from which the velocity components are derived by differentiation. *The first part* of the paper shows how it is more advantageous, in general, to make use of the relations between the Laplacians, or the Laplacians of the Laplacians, of these factors, than it is to make use of the relations of a lower order. It is shown that this extension greatly systematizes and simplifies the statement and the solution of problems on the motion of viscous fluids. *The second part* of the paper refers to what the author has ventured to call preharmonics, which are the triple integrals of harmonic functions which figure extensively in hydromechanics. It is shown how to find all of the preharmonics corresponding to all of the harmonic functions of positive and negative integral degrees.

Normal coordinates and Einstein space: G. D. BIRKHOFF.

Algebraic solutions of Einstein's cosmological equations: EDWARD KASNER.

The geometry of paths: OSWALD VEBLEN.

Biographical memoir of Dr. J. A. Allen: F. M. CHAPMAN.

Biographical memoir of Benjamin Apthorp Gould: G. C. COMSTOCK.

Biographical memoir of Henry Pickering Bowditch: W. B. CANNON.